# Site Pollution Prevention Plan
# for Los Alamos National Laboratory

**This plan is certified to meet the requirements of 40CFR 264.73.B9**

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## Table of Contents

# 1 Purpose and Strategy

## *1.1 Purpose of this plan*

The Site Pollution Prevention Plan for Los Alamos National Laboratory (the Laboratory) defines the strategy and plan for preventing environmental impacts from current Laboratory operations. It summarizes the pollution prevention plans of the Laboratory by waste or pollution type for Fiscal Years (FYs) 1997 through 1999.

This plan meets the requirement of Department of Energy (DOE) Order 5400.1 *General Environmental Protection Program* [DOE, 1988] for preparation of a site pollution prevention plan. The requirements of DOE Order 5400.1 encompass the requirements for pollution prevention planning in several statues and regulations.

## *1.2 Organization of this plan*

The plan consists of four chapters, references, and appendixes. The first chapter lays out the purpose and assumptions of the plan and the pollution prevention mission, and current status of the Laboratory. The second chapter defines the Laboratory's systems approach for pollution prevention including a description of the Environmental Stewardship Office (ESO). The third chapter describes the major waste types targeted for minimization, the strategy, and the current and planned activities for each waste type. The fourth chapter summarizes how the Laboratory will demonstrate accomplishment of the pollution prevention mission, including the relationship of individual activities to the DOE pollution prevention priorities. The chapters are followed by a list of references cited in the document, and an acronym list.

## *1.3 Site pollution prevention mission and strategy*

***Mission Statement****: Prevent adverse environmental impacts from Laboratory operation.*

This mission will have been achieved when all Laboratory processes, facilities, and systems have substantially eliminated waste generation and pollutant release to the environment. The strategy for executing this mission is for the Laboratory to identify systematically the most expensive and environmentally-threatening wastes and pollutants, and with DOE support, eliminate them with a graded approach. This strategy will be implemented in partnership with DOE. All employees are responsible for ensuring that their individual and collective actions take the Laboratory toward substantially eliminating waste generation and pollutant release.

## *1.4 Current status*

The Los Alamos National Laboratory mission is to "reduce the global nuclear danger." The Laboratory continues to research and develop tools and techniques that advance this mission in the fields of physics, chemistry, mathematics, computer science, materials science and life sciences, as well as related engineering disciplines. The Laboratory will also conduct non-nuclear testing, and limited production of War Reserve components in support of this mission. Preparations are currently underway for production operations including upgrading of several nuclear facilities.

In addition, the Laboratory's Environmental Management (EM) Program continues to manage wastes generated at the site, remedy environmental impact from past operational practices, and develop integrated scientific and technological solutions to global environmental problems. The Laboratory is preparing to dispose of significant quantities of legacy transuranic (TRU), mixed transuranic (MTRU), and mixed low level wastes (MLLW).

A limited research and development (R&D) effort is underway to develop new production processes that produce significantly less waste compared to past nuclear weapons production practices. In addition, several pollution prevention process and practice improvements have been identified for existing Laboratory nuclear weapons mission operations. The challenge for DOE and the Laboratory will be to find sources of funding to implement these pollution prevention opportunities.

In addition the Laboratory needs an active, forward-looking pollution prevention R&D program that would create the technological solutions necessary for future pollution prevention improvements. The pollution prevention solutions ready for implementation today were developed from 1989-1991 by a joint DOE Environmental Management

(DOE/EM)/Defense Programs (DOE/DP) pollution prevention R&D program. There is no equivalent program today.

Using the limited funding and support available from many sources, the Laboratory has recently implemented several pollution prevention solutions.

- Reduction of radiological control area (RCA), MLLW volume, and shipping container waste by the medical isotope program. [Funded by proceeds from isotope sales]
- Partnership with Johnson Controls, Inc. (JCI) and Los Alamos County to recycle 77% of sanitary waste. [Funded by Laboratory indirect]
- Partnership with (n,p) Energy, Inc. to recycle 2,000 $m^3$ of metal low level waste (LLW). [Funded by DOE Pollution Prevention Program, EM-77]
- Metallurgy Group (MST-6) avoidance of F-listed Resource Conservation and Recovery Act (RCRA) wastes (plating shop rinse water) with an evaporative recycling system. [Funded by the Laboratory Waste Management Program]
- Nuclear Materials Technology (NMT) Division development and implementation of the hydride-dehydride process for plutonium recovery avoiding aqueous recovery, generating no secondary waste. [Funded by DOE/DP]
- NMT Division's development of dry machining for plutonium, avoiding contaminated machining oils and coolants. [Funded by DOE/DP]
- NMT Division's development and implementation of pyrochemical processing of plutonium salts, avoiding liquid TRU waste from aqueous salt distillation. [Funded by DOE/DP]

In addition to these specific pollution prevention solutions, the Laboratory has implemented a number of measures to achieve the culture change to prevent pollution. These measures ensure that Laboratory employees who generate and manage waste are educated and motivated to prevent pollution in their area. Some of the most notable projects of this kind include:

- Development of a pollution prevention training module;
- Reduction in the size of RCAs and enforcement of the procedures to prevent unnecessary items from entering RCAs;
- Development of the procedures and instrumentation necessary to verify materials exiting RCAs as "clean" for disposal or recycle (Green Is Clean Program);
- Establishment of a Solid Waste Management Solutions Group(SWMSG), a Conservation Solutions Group, and a Pollution Prevention Council;
- Organization of pollution prevention consulting teams for major projects such as the Environmental Restoration (ER) Project, major upgrades projects and construction and upgrades planning;
- Development of a construction materials recycle center, redistribution and marketing center, and CHemical Exchange Assistance and External Recycle (CHEAPER) Program – all of which accept materials that would otherwise be disposed of; and
- Incorporation of pollution prevention performance measures in Appendix F of the contract between the University of California (UC) and DOE.

In addition to minimizing waste the Laboratory has undertaken a number of activities to reduce releases of pollutants to the environment. The Laboratory greatly reduced the number of stacks releasing hazardous and radioactive substances into the air. The Technical Area (TA)-16 steam plant has been replaced with a modular, significantly less polluting system. The number of effluent outfalls has also been reduced. Discharge of high explosive contaminated waste waters has been almost completely eliminated.

## *1.5 Assumptions*

**Laboratory operations**

- The Laboratory will be the primary DOE facility for plutonium research and development and for plutonium processing.
- The Laboratory will execute the following major missions:
  - ◊ research and development
  - ◊ medical isotope production

- ◊ stockpile stewardship and management, including remanufacturing of weapons components, and stockpile surveillance
- ◊ stabilization of weapons production residues in response to Defense Nuclear Facility Safety Board Recommendation 94-1 (DNFSB 94-1)
- ◊ workoff of legacy wastes
- ◊ environmental restoration of historically contaminated areas
- ◊ decontamination and decommissioning of obsolete facilities
- ◊ disposal of legacy wastes
- An increasing fraction of Laboratory waste producing activities will be subcontracted.

**Waste generation**

- Volumes, schedules and funding in the Los Alamos DOE/EM Ten Year Plan are accurate.
- DOE/EM Ten Year Plan upstream treatment projects will be funded.
- The Waste Isolation Pilot Plant (WIPP) will begin receiving TRU/MTRU in FY 1998.
- Generating programs will begin funding waste treatment, storage, and disposal costs in FY 1999.

**Pollution Prevention**

- A strong corporate pollution prevention effort will remain a Laboratory and DOE priority.
- The DOE will increase its emphasis on site-specific pollution prevention performance measures.
- The Generator Set-Aside Fee program will continue throughout FY 1998-2000.

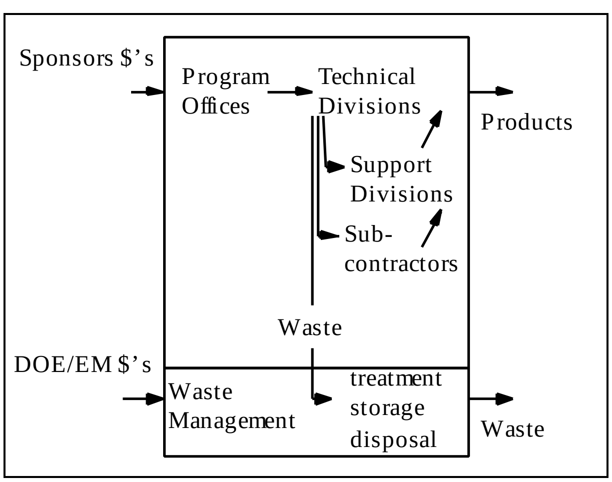



**Figure 2-1: Matrix Management**

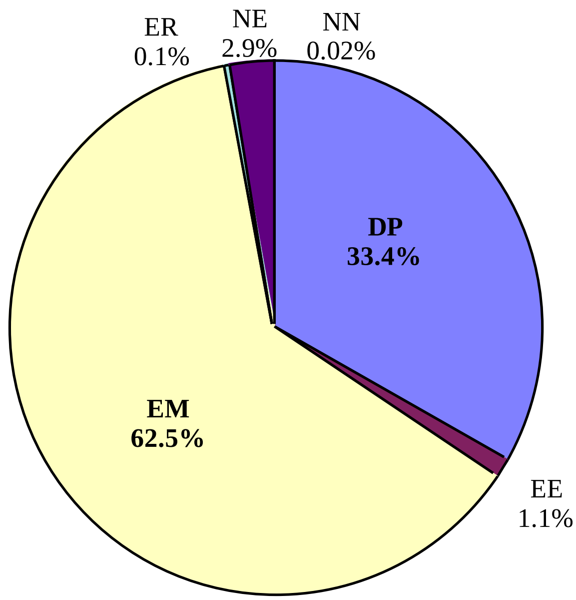



**Figure 2-2: Waste management costs by Cognizant Secretarial Office (CSO) for FY 1997**

| | | | |
|---|---|---|---|
| DP | Defense Programs | $ 11.5 | M |
| EE | Energy Efficiency | $ 0.4 | M |
| EM | Environmental Management | $ 21.9 | M |
| ER | Energy Research | $ 0.04 | M |
| NE | Nuclear Engineering | $ 1.0 | M |
| NN | Nuclear Nonproliferation | $ 0.006 | M |

## 2 Pollution Prevention Implementation

### *2.1 The Laboratory management system*

Laboratory management is organized in a matrix of program and technical/support divisions – sponsors contract with program offices who distribute funding to the appropriate technical divisions who accomplish and deliver the product. Technical divisions contract with support divisions and subcontractors for products and services. Technical and support divisions are responsible for pricing their products such that the cost of avoiding environmental impact is included. These relationships are shown schematically in Figure 2-1.

Management of newly generated and legacy waste is directly funded by DOE/EM. In 1999 waste generating programs will assume the cost of waste. Figure 2-2 shows the division of solid waste costs among the Laboratory's DOE program sponsors. (Some wastes handled by Laboratory EM Solid

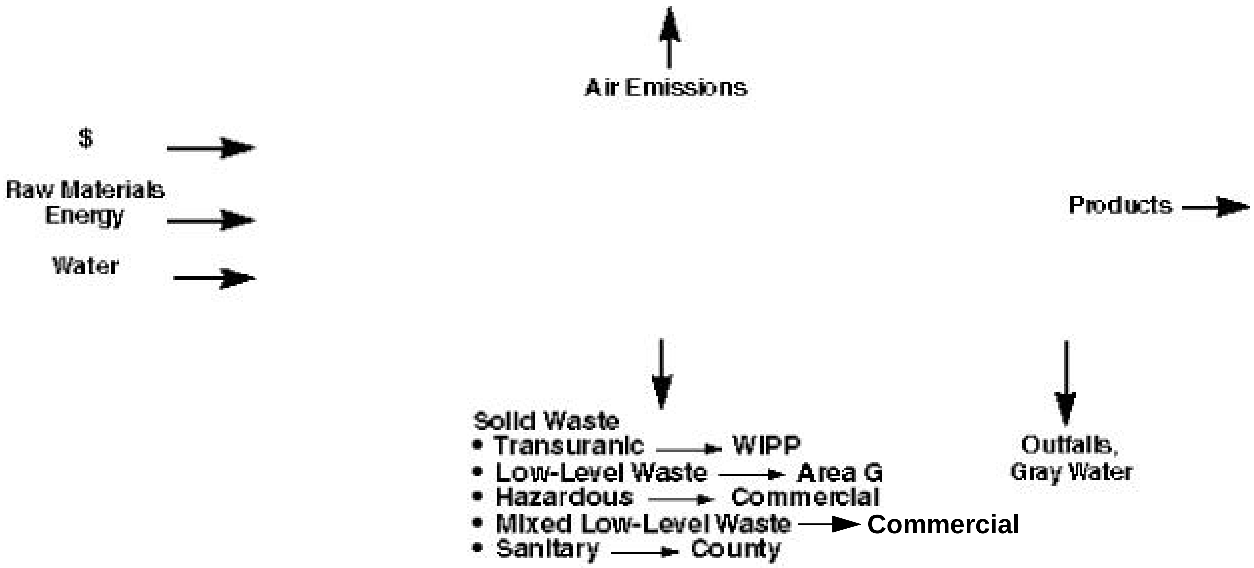



**Figure 2-3: Laboratory/environment system**

Waste Operations [EM/SWO] group consist of containerized liquids, and are included in this total.) Total FY 1997 solid waste cost is approximately $34 million. Costs for radioactive liquid waste handled by Laboratory EM Radioactive Liquid Waste operations (EM/RLW) are an additional $8 million. Management of air emission systems and effluent outfalls is funded by the emission/effluent generating programs. Management of regulatory permitting and inspection of emissions and effluents is funded either directly by mission programs or through the general and administrative (G&A) overhead charge.

## *2.2 The Laboratory-environment coupled system*

The Laboratory and the environment are a single, complexly coupled system. The Laboratory purchases equipment, commodities, energy, and water. The technical staff converts these into knowledge and other products for sponsors. This activity results in byproducts that are disposed of as waste if they cannot be otherwise reused or re-cycled. Wherever these are disposed of, they have some probability of impacting the environment. Laws and regulations determine how much impact is acceptable. The conversion process also results in air emissions and effluent outfalls. Again, laws and regulations, as interpreted by regulatory authorities, determine the concentrations of harmful substances allowable in these emissions and effluents (see Figure 2-3).

The Laboratory's choice in equipment and commodities purchased also impacts the environment. Those which contain significant recycled content avoid the environmental impact of extracting or refining virgin materials and the energy needed to process virgin materials. The quantities of energy and water used also impact the environment. Energy production results in carbon dioxide and other pollutants being released into the atmosphere. Present water usage is mining the aquifer – using water that isn't being replaced.

The Laboratory's systems approach considers waste and pollution as measures of the incompleteness of Laboratory processes. Each waste- or pollution-generating process is analyzed as a series of process steps. Each step is evaluated to determine the optimal improvement point where the system's environmental impact can be minimized most efficiently and at least expense.

## *2.3 Site pollution prevention goals*

The Laboratory pollution prevention goal is to substantially eliminate waste generation and pollutant release by 2010. The three steps to achieving this goal are as follows: 1) implement the best practices for pollution prevention and other improvements described in this three year plan, 2)

**Table 2-1: Current and anticipated waste volumes (in $m^3$), excluding ER Project waste**

| Year | Hazardous Waste | Low-Level Waste | Mixed Low-level Waste | TRU/ MTRU Waste |
|---|---|---|---|---|
| 1996* | 847 | 1,345 | 56.4 | 123 |
| 1997* | 928 | 3,928 | 74.5 | 213 |
| 1998* | 983 | 5,541 | 74.5 | 310 |
| 1999 | 979 | 5,541 | 71.5 | 311 |
| 2000 | 962 | 5,591 | 57.5 | 287 |
| 2001 | 945 | 5,591 | 43.5 | 249 |
| 2002 | 923 | 3,978 | 35.5 | 216 |
| 2003 | 1,314 | 3,978 | 39.3 | 194 |
| 2004 | 1,250 | 5,123 | 35.3 | 186 |
| 2005 | 1,194 | 5,123 | 27.3 | 178 |
| 2006 | 1,140 | 7468 | 23.3 | 170 |
| **Total** | **11,465** | **53,207** | **538.6** | **2,437** |

1996 waste volumes are actual volumes
Projections are from DOE/EM Ten Year Plan, Rev. 1
* newly generated 1996 – 1998 MLLW and TRU/MTRU waste is considered legacy waste.

implement technology-limited waste generation and pollutants release in all operations in partnership with DOE, and 3) secure DOE support for and develop new technology that eliminates the remaining wastes and pollutant releases.

**Table 2-2: Actual and anticipated ER Project waste volumes (in $m^3$)**

| Fiscal Year | Hazardous Waste | Low-Level Waste | Mixed Waste | TRU/ MTRU Waste |
|---|---|---|---|---|
| 1996* | 7,420 | 2,615 | 13.3 | 16.8 |
| 1997* | 803 | 2,106 | 275.8 | 10.0 |
| 1998* | 1,140 | 2,106 | 404.1 | 14.0 |
| 1999 | 1,077 | 2,106 | 368.8 | 13.0 |
| 2000 | 991 | 2,106 | 339.9 | 12.0 |
| 2001 | 991 | 2,106 | 339.9 | 12.0 |
| 2002 | 991 | 2,106 | 339.9 | 12.0 |
| 2003 | 991 | 2,106 | 339.9 | 12.0 |
| 2004 | 991 | 2,106 | 339.9 | 12.0 |
| 2005 | 991 | 2,106 | 339.9 | 12.0 |
| 2006 | 908 | 2,106 | 112.2 | 4.0 |
| **Total** | **17,294** | **23,675** | **3,213.6** | **129.8** |

FY 1996 waste volumes are actual volumes
Projections are from DOE/EM Ten Year Plan, Rev. 1
* newly generated FY 1996 – 1998 MLLW and TRU/MTRU waste is considered legacy waste.

In each step, a systems approach will guide the prioritization of wastes and pollutants to be eliminated. This prioritization will be based on threat to the environment and waste/pollutant cost. In this way the Laboratory will avoid most of the estimated future wastes listed in Table 2-1 and Table 2-2. By 2007, presently available technology will have been implemented, so that waste and pollutant releases will be technology-limited. By 2010, the Laboratory will approach zero waste generation and pollutant release.

This plan primarily covers the first, best pollution prevention practices step toward approaching zero waste and pollutant releases.

During the next three years, the Laboratory will accomplish the following:

- achieve the DOE Pollution Prevention goals (see next section),
- Reduce energy usage for all facilities except the Los Alamos Neutron Science Center (LANSCE) by 20% compared to a 1993 baseline,
- Formalize waste minimization planning in construction projects and Laboratory revitalization,
- eliminate all routine, non-R&D MLLW,
- downgrade all suspect LLW and, where practicably decontaminatable, LLW to sanitary waste,
- secure DOE support for sufficient pollution prevention research to address future mission needs, and
- secure DOE support for pollution prevention upgrades of the TA-55 Plutonium Facility.

## *2.4 DOE pollution prevention goals*

The Secretary of Energy has set goals for the prevention of pollution through reduction in the volume of waste generated by routine operations, and through affirmative procurement and recycling for all operations. The recent historic waste volumes are summarized in Table 2-3. The Departmental goals are summarized in Table 2-4, with the quantities reported being the target volumes and percentage reductions for the Laboratory. The FY

1997 projected goals represent current performance estimates. The Laboratory is on track to meet or exceed all goals.

### *2.5 Organization for implementing the pollution prevention strategy*

The Laboratory Director has delegated responsibility for leading pollution prevention to the Director of EM for the Laboratory. EM has established an Environmental Stewardship Office (ESO) to integrate the Laboratory's pollution prevention effort into a systems framework. ESO disseminates data on the generation of waste and pollution, establishes incentives for pollution prevention, and brokers pollution prevention investment projects. ESO also reports Laboratory pollution prevention performance and plans to DOE. Each major waste- or pollution-generating division is responsible for organizing its own pollution prevention plan, process, and implementation. Laboratory-wide pollution prevention efforts are integrated and coordinated through a Pollution Prevention Council.

**Table 2-3: Waste volumes for Calendar Years 1993-1996**

| Waste Type | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|
| **Hazardous** | | | | |
| Routine | 307 | 337 | 134 | 91 |
| Nonroutine | 437 | 923 | 2,259 | 6,999 |
| *Total* | *744* | *1,260* | *2,393* | *7,097* |
| **LLW** | | | | |
| Routine | 1,991 | 1,763 | 1,088 | 531 |
| Nonroutine | 585 | 148 | 1,944 | 4,138 |
| *Total LLW* | *2,576* | *1,911* | *3,032* | *4,669* |
| **MLLW** | | | | |
| Routine | 12.3 | 20.5 | 7.3 | 6.8 |
| Nonroutine | 11.8 | 50.4 | 79.6 | 58.2 |
| *Total* | *24.1* | *70.9* | *86.8* | *65.0* |
| **TRU/MTRU** | | | | |
| Routine | 76.8 | 61.9 | 83.4 | 80.8 |
| Nonroutine | 219.2 | 21.0 | 11.7 | 57.4 |
| *Total* | *295.9* | *83.0* | *95.1* | *138.2* |

Radioactive and mixed wastes in cubic meters and hazardous and sanitary wastes in metric tonnes. CY 1993 is the baseline year for DOE Pollution Prevention Goals. Totals reflect sums of unrounded numbers.

## *2.6 Pollution prevention funding*

Pollution prevention is the responsibility of every organization that produces waste or otherwise impacts the environment. Support for the Laboratory's corporate (Environmental Stewardship) pollution prevention activities come from the DOE Pollution Prevention Program (EM-77, administered through DOE Albuquerque Operations [DOE/AL]) through Activity Data Sheet (ADS) 7000. Pollution prevention funding for new mission activities is provided by those mission's program sponsors – as the DOE complex and the Laboratory build pollution prevention into all new activities. Funding for projects that reduce the environmental impact of existing programs and Laboratory-wide pollution prevention projects comes from:

**Generator Set-Aside Fee (GSAF) program** This pilot program collects a fee, equal to 5% of Treatment, Storage and Disposal (TSD) costs, for all waste generated on site. Proceeds are used to fund pollution prevention investments. In FY 1996 $719,000 was collected, and seven projects were funded at a cost of $399,900.

**Table 2-4: Los Alamos National Laboratory pollution prevention goals for CY 1997 - 1999**

| | 1993 (Baseline)[1] | Projected 1997 Goals | | Projected 1998 Goals | | Projected 1999 Goals | | DOE Goals 12/31/99 |
|---|---|---|---|---|---|---|---|---|
| **Goal** | **Quantity[2]** | **Quantity[2]** | **%[3]** | **Quantity[2]** | **%[3]** | **Quantity[2]** | **%[3]** | **%[3]** |
| ***Routine Waste-Generating Operations*** | | | | | | | | |
| Reduction of Toxic Release Inventory (TRI) chemicals | 0[3] | 0[3] | 0%[3] | 0[3] | 0%[3] | 0[3] | 0%[3] | 50% |
| Reduction of low-level radioactive waste generation | 1,991 | 1,354 | 32% | 1,195 | 40% | 1,035 | 48% | 50% |
| Reduction of low-level mixed waste generation | 12 | 8 | 32% | 7 | 40% | 6 | 48% | 50% |
| Reduction of hazardous waste generation | 307.4 | 209 | 32% | 184.4 | 40% | 159.8 | 48% | 50% |
| Reduction of sanitary waste generation | 2.78 | 2.22 | 20% | 2.09 | 25% | 1.95 | 30% | 33% |
| *All Operations* | | | | | | | | |
| Increase in sanitary waste recycling % = (recycled amount x 100)/ (SAN waste + recycled) | | | 77% | | 79% | | 81% | 33% |
| Increase in affirmative procurement of EPA-designated recycled products | | | 17% | | 34% | | 50% | 100% |

1 From 1994 Annual Report on Waste Generation and Waste Minimization Progress
2 Radioactive and mixed wastes in cubic meters and hazardous and sanitary wastes in metric tonnes
3 Percentage reduction
4 Los Alamos National Laboratory has reported no off-site transfers of TRI chemicals since the TRI program began in 1993

**DOE/AL High Return On Investment Program (ROI)** The DOE/AL program has funded five projects in FY 1997, for a total of $646,600, to reduce TRU/MTRU waste, LLW, and HAZ wastes. Prior year projects from a DOE/HQ program have continuation funding of $300,000.

**DOE complex-wide program** DOE/AL funds pollution prevention projects that benefit multiple DOE sites.

**Environmental Management Technology Deployment Initiative (TDI)** The DOE Environmental Management Office (DOE/EM) has proposed setting aside ~$50,000,000 in FY 1998 for projects which will create opportunities for, and accelerate deployment of, innovative cleanup solutions.

**Mission programs** Mission programs are responsible for funding pollution prevention as an integral and fundamental component of all operations at Los Alamos.

**Institutional funding** Site wide pollution prevention is supported through the Laboratory's G&A overhead.

Anticipated FY 1997-1999 funding profiles by funding source are shown in Table 2-5.

## *2.7 Environmental Stewardship Office*

The ESO leads the Laboratory-wide pollution prevention effort. ESO has three functions: to collect and disseminate waste generation and pollution data, to market pollution prevention to all waste or pollution generators, and to broker pollution prevention and waste minimization projects. ESO is part of the Laboratory's Environmental Management Program – which is the largest waste generating program and manages the disposal of all the Laboratory's waste, except sanitary waste.

ESO is formally designated as a program office. It is staffed by five UC personnel (Table 2-5) and supported by three subcontractor administrative personnel. ESO manages pollution prevention projects in technical and support divisions. ESO also manages pollution prevention projects accomplished by subcontractors. ESO-managed programmatic activities include: ADS-7000 (pollution prevention base program and DOE/AL ROI projects), ADS 3341A (DOE/EM-77 pollution prevention projects), ADS-4172 (Waste Management Program Upstream Treatment Projects), Laboratory indirect projects, and the Generator Set-Aside Fee Program.

The ESO is supported by several other Laboratory organizations: Environmental, Safety and Health (ESH) Division monitors and supports environmental compliance; the EM/SWO and EM/RLW) groups and the TRU waste team in Chemical Science and Technology (CST) Division manage waste data, end-of-pipe waste minimization, and also processing of legacy wastes; and the Facilities,

**Table 2-5: Pollution prevention staff levels, and requested and actual funding levels for pollution prevention activities by fiscal year**

| Activity | 1997 Request | 1997 Funding | 1998 Request | 1999 Request |
|---|---|---|---|---|
| Laboratory Pollution Prevention Staff Level | | 5 | 5 | 5 |
| ADS 7000: Base Program | $2,250,000 | $1,250,000 | $1,250,000 | $1,250,000 |
| ADS 7000: High ROI Projects | $1,625,600 | $764,600 | $500,000 | $600,000 |
| ADS 3341A: DOE/HQ High ROI Projects | $300,000 | $300,000 | 0 | 0 |
| ADS 4172: Waste Management Operations (Upstream Treatment Projects) | $2,000,000 | $75,000 | $1,305,000 | $2,630,000 |
| Mission Program Projects | $5,000,000 | $0 | $5,000,000 | $5,000,000 |
| Generator Set-Aside Fee Program | $900,000 | $900,000 | $900,000 | $900,000 |
| **Total** | **$12,075,600** | **$3,289,600** | **$8,955,000** | **$10,380,000** |

Safeguards, and Security (FSS) Division manages the Energy Conservation Program.

The Stewardship Office functions are described in the next two sections: base program (which includes site-wide pollution prevention incentives and marketing) and waste/pollution type support (which includes the brokering of pollution prevention projects).

The ESO manages the Lab's waste avoidance data and combines it with air emissions, effluent release, energy usage, procurement, and waste generation data to build a total, Laboratory-environment system picture.

The ESO has assigned a waste type coordinator to each of the waste and pollution streams: TRU/MTRU waste, MLLW, LLW, hazardous waste, sanitary waste, air emissions, effluent outfalls, and conservation. ESO also has Affirmative and Pollution Prevention Procurement Projects that develop incentives for environmentally conscious procurement choices.

## *2.8 Pollution prevention base program*

The mission of the Pollution Prevention Base Program is to lead the Laboratory efforts to reduce waste generation and to minimize the environmental impact of past, current, and future Laboratory operations while improving cost effectiveness, productivity, and technical capabilities. These constitute mainly the functions of marketing pollution prevention and gathering and selling data. The major tasks of the base program, described in the ADS-7000 baseline, are summarized here.

**Program management** The program management task is responsible for developing and managing the pollution prevention base program, and developing the baseline each fiscal year. It coordinates the base program with Pollution Prevention projects, and prepares this Site Pollution Prevention Plan. The task activities also include responding to DOE requests for information and review.

**Technical assistance** Technical assistance includes providing waste minimization and pollution prevention assistance to generators. It also includes development of the systems flow sheets and waste stream analysis for each waste type.

**Data tracking and reporting** The data tracking and reporting task consists of collecting, analyzing, and reporting data for all pollution prevention and waste avoidance data calls, performance measures, and other required reports, as well as maintaining information distribution channels. Data reporting includes providing waste generation and waste avoidance data to division managers. It includes providing division and group waste generation and avoidance performance data to managers for consideration in subordinate manager's annual appraisals.

**Site-wide reduction** The site-wide reduction effort supports reduction of sanitary waste through a redesigned recycling program, and implementation of pollution prevention tools in the Total Integrated Procurement System (TIPS). In addition, the task assists mission programs with purchasing products with recycled materials content and prepares the annual Affirmative Procurement Report.

Site-wide reduction also includes the development of a Waste Minimization and Pollution Prevention standard. Laboratory Performance Requirements (LPRs) will be developed for each waste and pollution stream, and for conservation of energy, water, and other natural resources. Under these LPRs Laboratory Implementing Requirements and Guidance will be developed as necessary. These requirements and guidance documents will identify and formalize Laboratory-wide pollution prevention and waste minimization practices that assist in meeting the pollution prevention goal.

**Employee involvement** Employee involvement activities include development of employee training modules on pollution prevention and waste minimization, and management of the Pollution Prevention Award Programs. Preparation of the *P2 Reporter* and other efforts to showcase Laboratory pollution prevention successes also fall under this task.

**Outreach and public relations** The outreach and public relations effort publicizes activities that emphasize pollution prevention practices, and encourages public participation in pollution prevention planning and implementation activities.

**Waste type program support** The ESO has designated waste type coordinators for each waste type. The coordinators work with waste generators and with Waste Management Program waste type managers to develop a system framework, a strategy, and target waste streams and minimization options for each waste type. Descriptions of waste minimization efforts for TRU/MTRU, MLLW, LLW, Hazardous, and sanitary waste are presented in chapter 3. Descriptions of pollution prevention efforts for air emissions, effluent outfalls, and energy conservation will be developed during the first year of this plan.

# 3 Waste Type Minimization

## *3.1 TRU waste minimization*

### 3.1.1 Background

TRU waste consists of materials contaminated with radioactive elements with atomic number (Z) greater than that of uranium (Z=92), and with half lives greater than 20 years. The contamination must be present at levels greater than 100 nanoCuries per gram (nCi/g) at the time of assay (DOE, 1988). MTRU waste is also contaminated with RCRA constituents. Most data cited in this description are from the LANL TRU Waste Management Plan, Rev. 0 LANL, 1996d.

TRU waste at the Laboratory is classified into two categories – legacy waste and newly generated waste. TRU and MTRU wastes are reported separately due to the differing characterization requirements applied to wastes which include RCRA constituents, and because the Federal Facilities Compliance Order/Site Treatment Plan (FFCO/STP – NMED, 1995) stipulates treatment requirements for MTRU wastes. If WIPP receives a No Migration Variance, characterization requirements will remain. However, the waste will presumably be shipped to WIPP without treatment, except as needed to meet storage requirements. In the following sections, TRU/MTRU will be discussed as one as the waste minimization strategy for both waste types is the same.

Wastes are accumulated and characterized at the generation site, then transported to the TRU waste characterization areas at TA-54 or TA-50. Further characterization of TRU wastes occurs at Building 54-34, the Radioassay and Nondestructive Testing facility (RANT), and at Building 50-69, the Waste Characterization, Reduction and Repackaging Facility (WCRRF). Samples for characterization from drums in some cases are sent to the Chemical and Metallurgical Research (CMR) building for analysis. TRU/MTRU waste is stored at TA-54, Area G. Certification of the waste for transport and disposal at WIPP is the responsibility of Environmental Science and Waste Technology Group (CST-7). Shipping of waste to WIPP is anticipated to begin in FY 1998.

Estimated costs for handling, storage and disposal of TRU/MTRU waste are $50,000/m$^3$, based on average costs per unit volume from the available draft of the DOE/EM Ten Year Plan.

### 3.1.2 Waste type description

As of December 31, 1995, 11,167m$^3$ of TRU and MTRU waste were stored at the Laboratory. Of this volume, 2,596m$^3$ could potentially be reclassified as “buried” TRU and MTRU waste, and removed from the inventory of waste to be sent to WIPP. The remaining volume is considered retrievably stored, and under consideration for shipment to WIPP. Much of the legacy waste may have to be repackaged for shipment to WIPP, generating significant volumes of secondary waste (both repackaged volume and waste generated by repackaging).

Between 1989 and 1995, TRU waste generation ranged from ~60 to ~310m$^3$ per year. Analyzing these wastes provides insight into the generation rates for future TRU waste.

The volumes of TRU/MTRU waste generated over the last three years are displayed in Figure 3-1, separated into three categories – routine; nonroutine, non-ER; and ER waste. The routine waste has varied over this period by 22%, rising between 1994 and 1995, then decreasing in 1996. This variation

**Table 3-1: TRU/MTRU waste volumes by Fiscal Year (1994-1996) in m$^3$**

| TRU | 1994 | 1995 | 1996 |
|---|---|---|---|
| **Routine** | 71.6 | 87.1 | 76.9 |
| **Non Routine (non-ER)** | 23.5 | 6.1 | 46.2 |
| **ER** | 0.0 | 0.0 | 16.8 |
| **Total** | **95.0** | **93.2** | **139.9** |

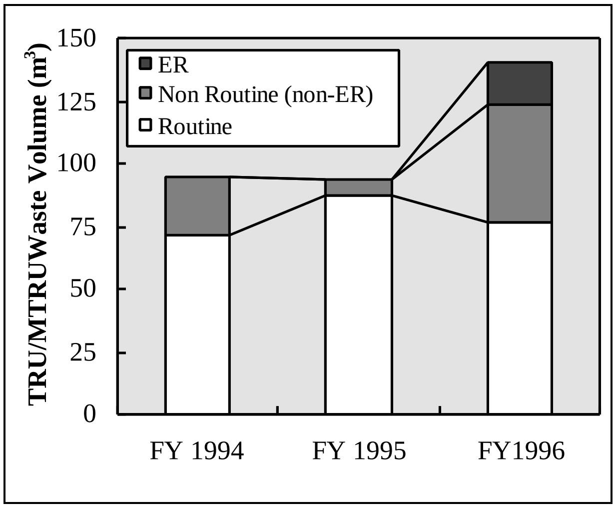



**Figure 3-1: TRU/MTRU waste generation by fiscal year**

reflects variations in the generation of TRU/MTRU waste by CST Division analytical work in preparation for certification of TRU/MTRU waste for the WIPP opening. Nuclear Materials Technology (NMT) Division waste volumes have increased steadily over this interval, reflecting increased activity in response to the Defense Nuclear Facility Safety Board (DNFSB 94-1).

The nonroutine, non-ER waste has varied by a factor of >7x over this interval, from 6m$^3$ (1995) to 46m$^3$ (1996), reflecting several stages of the upgrade of the CMR facility, and upgrades to laboratories at TA-55. These varying waste volumes indicate the uncertainty inherent in projecting nonroutine waste volumes. The ER waste has increased from zero in 1994 and 1995 to 17m$^3$ in 1996, reflecting the transition from mainly characterization to remediation and D&D effort in the ER Project.

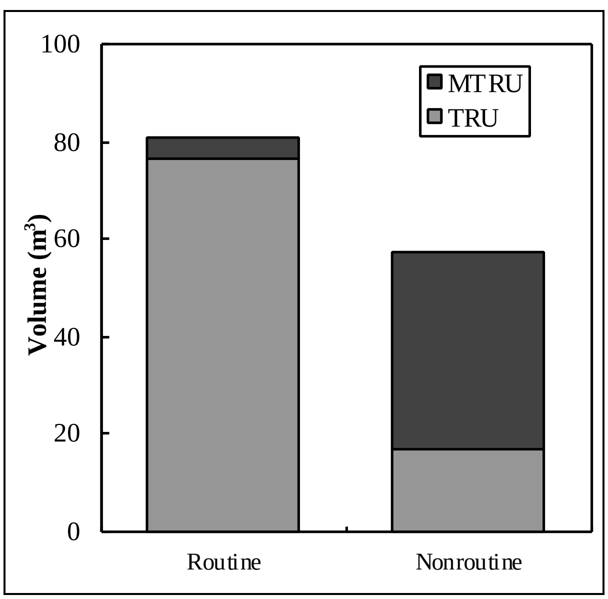



**Figure 3-2: Routine and nonroutine volumes of TRU and MTRU waste, CY 1996**

TRU waste volume for CY 1996 consisted of 76.4 m$^3$ of routine TRU waste, 16.7 m$^3$ of nonroutine TRU waste, 4.4 m$^3$ of routine MTRU waste, and 40.6 m$^3$ of nonroutine MTRU waste (Figure 3-2). For routine wastes, significant efforts have already reduced the proportion of TRU waste which is mixed waste. Nonroutine wastes, which commonly come from upgrading of facilities, are likely to be mixed as a consequence of their history, and avoiding the commingling of constituents may not be possible.

As increasing amounts of plutonium residues are processed, TRU waste generations should again reach its historic high in FY 1998. In FY 1999, when wastes from mission program operations will be officially designated newly-generated TRU, the annual rate is forecast to be 324 m$^3$. Unless treatment options proposed in the DOE/EM Ten Year Plan are implemented, waste volumes will continue at that rate for the remainder of the ten years. With the Upstream Treatment Projects, the waste volumes projected are shown in Table 3-2

### 3.1.3 Participating facilities

In CY 1996, the Plutonium Facility at TA-55 generated 76% of the TRU/MTRU waste at the Laboratory. In most prior years, TA-55 has been responsible for >90% of the TRU/MTRU waste volume. The routine waste generated at the plutonium processing facility consists of materials from processing of plutonium metal and residues, including metal preparation, oxide production, and scrap recovery. Casting, machining, measuring and cleaning of plutonium pits and other weapons materials generates a wide variety of TRU/MTRU wastes.

A significant fraction of these materials is recycled through various secondary processes, including thermal decomposition, calcining, leaching, and aqueous dissolution. These recovery processes generate handling wastes and various liquid or sludge wastes. A portion of these sludges is cemented into a homogeneous waste form at TA-55, whereas another fraction is sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA–50 for treatment, and ultimately is cemented.

A separate wing of the TA-55 Plutonium Facility generates wastes contaminated with $^{238}$Pu from production and reprocessing of neutron generators and radioactive thermoelectric generators (RTGs).

Nonroutine wastes generated at TA-55 generally result from rebuilding and upgrading of facilities, including construction waste, discarded gloveboxes, and the content of those gloveboxes.

The CMR Facility was responsible for 4% of the TRU/MTRU waste, which consisted of Laboratory debris (combustible, metal and glass) from the wide variety of research and analytical laboratories supporting the weapons program and other programs.

Nonroutine waste from CMR consists of a variety of construction debris and gloveboxes from routine rebuilding and upgrading, but more significantly from the construction efforts underway as part of the major upgrade for the Stockpile Management mission.

The ER Project was responsible for 12% of the TRU/MTRU waste in CY 1996, primarily from the decontamination and decommissioning of plutonium and uranium handling facilities at TA-21. The large, nonroutine volume from Environmental Restoration has been atypical.

A breakdown by division in shown in Figure 3-3. NMT Division operates TA–55; CST Division conducts analytical operations at TA–55 and at CMR, as well as legacy TRU waste handling activities at TA–50 and TA–54. The Environmental Restoration Project generated TRU/MTRU from D&D activities.

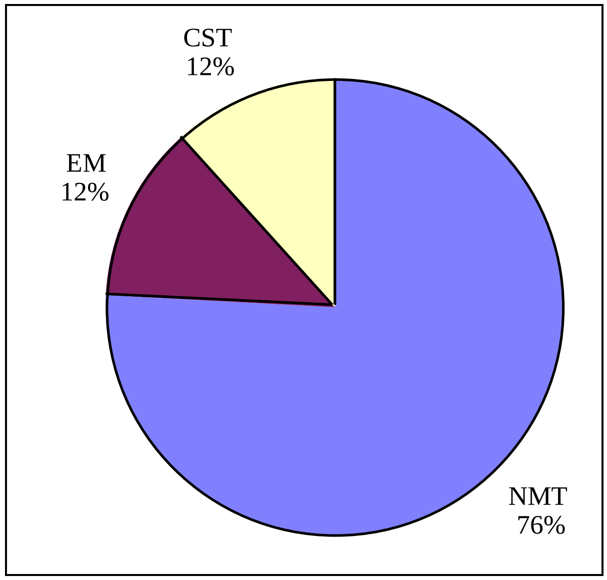



**Figure 3-3: TRU/MTRU waste generation for CY 1996 by division**

NMT – Nuclear Materials Technology Division
CST – Chemical Science & Technology Division
EM – Environmental Management Program

### 3.1.4 Major waste stream characteristics

The TRU/MTRU waste is dominated by six waste stream components, which account for ~96% of the TRU/MTRU waste generated.

**Table 3-2: Actual and anticipated TRU/MTRU waste volumes (in m$^3$)**

| Fiscal Year | Non-ER Volume | ER Project Volume |
|---|---|---|
| 1996* | 123 | 16.8 |
| 1997* | 213 | 10.0 |
| 1998* | 310 | 14.0 |
| 1999 | 311 | 13.0 |
| 2000 | 287 | 12.0 |
| 2001 | 249 | 12.0 |
| 2002 | 216 | 12.0 |
| 2003 | 194 | 12.0 |
| 2004 | 186 | 12.0 |
| 2005 | 178 | 12.0 |
| 2006 | 170 | 4.0 |
| **Total** | **2,437** | **129.8** |

FY 1996 waste volumes are actual volumes
Projections are from DOE/EM Ten Year Plan, Rev. 1
* newly generated non-ER MLLW and TRU/MTRU waste generated in FY 1996 – 1998 is considered legacy waste.

- *Combustible waste* (~44%) – mainly organic materials, predominantly plastics, paper, rubber and wood.
- *Metal waste* (~25%) – predominantly lead and stainless steel. A significant additional volume of metal waste is likely to be generated by upgrade and construction projects, and has not been fully captured in TRU/MTRU projections.
- *Combined combustible and noncombustible waste* (11%) – wastes containing >10% combustible material, and >10% non-combustible material, generated at the WCRRF. This waste stream consists predominantly of gloveboxes and glovebox trash packaged without segregation.
- *Hydrogenous sludge from nitric acid process line* (~10%)
- *Hydrogenous sludge from treatment of the caustic residue from the hydrochloric acid process line* (~3%)
- *Glass waste* (~3%)

Most of the TRU waste is contaminated with plutonium isotopes, predominantly $^{239}$Pu and with related daughter product isotopes, such as $^{241}$Am. The remainder of the waste (~10%), from production of neutron sources and radioactive thermoelectric generators, contains $^{238}$Pu, and is largely a combustible waste stream.

Up to 10% of the $^{239}$Pu and $^{241}$Am-contaminated waste, primarily in the form of cemented evaporator sludges, and most of the $^{238}$Pu-contaminated waste are currently packaged in drums which exceed the currently permissible thermal loading limits for transportation. These thermal limits are conservatively set in the WIPP Waste Acceptance Criteria (WAC) [DOE, 1996] to ensure that hydrogen is not generated in sufficient quantity to cause a combustion hazard during transportation.

These two waste types, defined as special case wastes for the DOE/EM Ten Year Plan, are significant targets for minimization, as the repackaging of these wastes would generate large volumes of secondary waste (in some cases requiring a 100-fold volume increase).

### 3.1.5 Recent accomplishments

- Implementation of nitric acid recycle (expected by FY 1998), which will reduce acid discharge ~90%, permit TA-55 to meet regulatory discharge limits, and reduce the volume of TRU waste generated from the nitric acid process system. [Funded by DOE/DP]
- NMT Division development and implementation of the hydride-dehydride process for plutonium recovery, which avoids aqueous recovery, generating no secondary waste. [Funded by DOE/DP]
- NMT Division's development of dry machining for plutonium, which avoids contaminated machining oils and coolants. [Funded by DOE/DP]
- NMT Division's development and implementation of pyrochemical processing of plutonium salts which avoids liquid TRU waste from aqueous salt distillation. [Funded by DOE/DP]
- ER Project D&D team completion of decontamination of ductwork in TA-21, Building 146 (Filter Building) using strippable coatings and wire brushes, which reduced 120 $m^3$ of TRU material to LLW. [Funded by DOE/EM]

### 3.1.6 Strategy and current targets

*Legacy waste*

The Laboratory has identified two areas for minimization of legacy TRU/MTRU waste: 1) sorting and segregating wastes that must be repackaged, and 2) minimizing waste generated in characterization of wastes for WIPP certification.

Repackaging will be necessary for two main classes of waste. Waste stored in non-standard containers will require repackaging to be certifiable for transportation in TRUPACT II containers. Most prominent among these wastes are large, fiberglass-reinforced plywood boxes containing gloveboxes and assorted trash. These are targeted in the DOE/EM Ten Year Plan for sorting, segregation, and repackaging with much of the volume being disposed of as LLW. In addition, a TDI proposal has been submitted to support rapid deployment of improved technology for decontamination of some of this material.

The second category of legacy TRU/MTRU waste requiring repackaging consists of drums and standard waste boxes which exceed thermal load limits for transportation to WIPP. To reduce the need to repackage these wastes, experiments are under way which should permit relaxation of the thermal loading limits by a factor of 2-3 (LANL 1996d). Much of the cemented waste with high $^{241}$Am content should meet such relaxed requirements. The volume of $^{238}$Pu-contaminated waste in the legacy is small, but may require other efforts to avoid very large volume repackaging.

*Newly-generated waste*

This section discusses waste minimization for newly-generated wastes, and for those wastes generated in FY 1996-1998 called legacy waste in the DOE/EM Ten Year Plan. Efforts to reduce newly-generated TRU waste focus, of necessity, on activities at TA-55. Secondary targets are the debris waste and aqueous process wastes from chemical analytical and research processes at the CMR facility and at TA-48.

Operations at TA-55 are constrained by safety, security and criticality concerns. The review process for any change in procedure there is lengthy and can be very expensive. Thus, rapid returns on investment are not generally possible. Careful evaluation of life-cycle cost and benefit is needed. Such evaluations should include the potential high vulnerability of the site to single incidents and minor non-compliances. A waste minimization plan is already in place for TA-55 (Foxx, 1995), and many of the projects described in that plan are expected to be implemented as funding becomes available.

*Combustible waste:* The most important target for waste minimization is combustible waste. Much of this waste volume consists of extra layers of plastic and entrapped air resulting from bagging out of small waste volumes for off-line radioactivity monitoring. NMT Division plans to reconfigure the solid waste management rooms in the PF-4 wing of the Plutonium Facility to allow accurate assay of waste for nuclear material content within the glovebox system (Foxx, 1995).

With the in-line assay of waste, it becomes possible to place waste inside a large plastic bag attached to the glovebox, but hanging into a 55-gallon drum. The associated reduction of packaging (~80%) will increase packaging efficiency by ~50%, and may result in as much as 20% total volume reduction of TRU/MTRU waste. This project is expected to be proposed for joint funding by DOE/EM and DOE/DP in FY 1998.

A second target for reduction will be the combustible wastes contaminated with $^{238}$Pu. A proposal has been submitted to the DOE/EM Technology Deployment Initiative to implement Molten Salt Oxidation to reduce the hydrogen content of materials from the $^{238}$Pu processing line. The residue would then be processed through an aqueous processing line, with recovery of the $^{238}$Pu. Enhancements to current aqueous processing techniques would include:

- Better ion exchange resins, to remove more Pu from the aqueous stream,
- Extraction chromatography, to polish the waste stream, and
- Ultrafiltration, to remove insoluble fractions from the neutralized waste stream after extraction chromatography.

Funding is also anticipated from the Office of Nuclear Energy (DOE/NE).

In addition, improved instruments to monitor suspect TRU waste, in combination with sorting and segregation are anticipated to reduce volumes significantly. These have been funded at CMR through the GSAF program and are expected to be operational at CMR in FY 1998.

*Metal waste:* Because the new Stockpile Stewardship missions are driving major efforts to maintain and improve capabilities, up to 400 gloveboxes are expected to be removed over the next few years. The volume of these wastes is not likely to be fully captured in the existing waste volume projections.

A team from NMT Division has developed a widely applicable approach to electrolytic decontamination of these metals, which may ultimately lead to reuse of some portion of the gloveboxes, and disposal of the rest as LLW. The process has been successfully tested on bare metal gloveboxes. Development is under way by team members in CST Division of an instrument to remove paint as well. These instruments are being proposed for deployment through the TDI and are currently funded in part through High Return-on-Investment funding through DOE Albuquerque Operations (DOE/AL).

The long-term glovebox strategy is to work with glovebox manufacturers to develop a glovebox that is designed for reuse and eventually recycling. In addition, the waste volumes potentially avoided by more attentive design of facility upgrades, construction, and operational procedures will be targeted as waste minimization opportunities based on experience from CMR and other building upgrades.

*Combustible/noncombustible waste:* This waste stream was only defined in FY 1996, and integration into the TRU/MTRU waste system model is at an early stage. The waste stream consists of both combustible and noncombustible materials mainly metal and debris wastes from gloveboxes projected to be removed as part of refitting of operational facilities. These wastes will be generated primarily at the WCRRF, and will constitute nonroutine, secondary wastes. The strategy for these wastes is likely to be the same as that for the metal glove boxes described above. Some sorting and segregation may also need to be funded.

*Hydrogenous sludge from nitric acid process line:* Efforts are currently under way through the DOE/AL High ROI program to reduce the volume of homogeneous cemented waste through improved recovery of Pu. Complete testing of waste minimizing improvements to TA-55 nitric acid process line, including optimization of anion resins and improvement of recovery from oxalate precipitation, is expected by the end of FY 1997. Implementation is expected to be completed in FY 1998.

In addition, waste forms that allow higher levels of waste loading are being considered, such as calcining and vitrifying along with use of sealed pipe components to allow higher loadings. Recent approval of the pipe component as a treatment (encapsulation) option has modified the direction of some investigations from attempting to reduce the radionuclide content through enhanced recovery of $^{241}$Am to conversion to calcined $^{241}$Am.

Idaho National Engineering and Environmental Laboratory has recently undertaken design and construction of a vitrification unit for TA-55, with funding from DOE/DP. Funding to conduct readiness review and cold testing is part of the Laboratory's Ten Year Plan submission in FY 1998, with continued support in FY 1999 and FY 2000. Funding for that project is essential to ensure that future waste in this stream can be certified for shipment to WIPP.

Reusable metal molds have been proposed to replace graphite molds currently used at TA-55. The reusable molds result in lower charge wastes, which leads to less plutonium recovery in the aqueous processing lines. These lower processing amounts should reduce not only the volumes for the nitric acid process line, but will also reduce the combustible organic wastes which are the largest volume waste stream.

The current casting system generates significant volumes of oxides as a result of a poor vacuum system. Improvements to two furnaces are anticipated in FY 1998. These improvements, if carried out for all four furnaces would reduce another feed stream to the plutonium recovery processes, reducing both the volume of direct wastes in the recovery process, and the handling wastes at all intermediate stages.

*Hydrogenous sludge from treatment of the caustic residue from the hydrochloric acid process line:* Current GSAF funding has been allocated to support a project at TA-55 to substitute magnesium hydroxide for alkali hydroxides in the hydrochloric acid dissolution line. This modification has been shown to reduce significantly the radioactive content of caustic liquids transferred to the Radioactive Liquid Waste Treatment Facility (RLWTF). The magnesium hydroxide will be derived by grinding and dissolution of existing TRU-contaminated magnesia crucibles, thus reducing one waste stream while eliminating another. Continuation funding to move this process modification through review will come primarily through DOE/DP.

Salt from electro-refining processes (which separate plutonium from americium) can be reacted with carbonate to oxidize volatile actinide species such as chlorides, metal, and oxychlorides. The salt can then be distilled, separating the very low volatility oxides from the higher volatility salts. The clean salt can be recycled, and the small volume of oxides can be stored, or returned to the process stream for purification. This process can potentially eliminate salt wastes from the hydrochloric acid process waste stream. As with the other projects, combustible wastes from handling of materials will also be reduced.

In addition, other projects are being proposed for reduction and eventual elimination of the hydrochloric acid waste stream through a variety of improvements described in greater detail in the TA-55 Waste Minimization Plan (Foxx, 1995).

*Glass waste:* The glass waste stream is targeted for inclusion in the vitrification stream, once vitrification of the nitric acid process sludges becomes routine.

### 3.1.7 Immediate, near-term, out-year activities

*Immediate Priority - Implementation by FY 1998*

- Complete testing of waste minimizing improvements to TA-55 nitric acid process line.
- Develop internal performance measures for increased production activity.
- Provide direct waste minimization support to the Stockpile Stewardship activities during construction upgrades of the Capability Maintenance and Improvement Project.

*Near-Term Priority - Implementation by FY 1999*

- Implement process improvements to TA-55 nitric acid line through safety assessment and readiness review.
- Implement vitrification of nitric acid evaporator bottoms, through hot testing.
- Develop closed-loop recycle for TA-55 hydrochloric acid process line through use of MgO crucibles as caustic precipitation agent in line.
- Implement electrolytic glove box decontamination for rebuilds, upgrades, D&D, and legacy waste treatment.
- Implement in-line monitoring of TRU wastes.
- Transfer responsibility for project funding to generator organizations.

*Out-year Activities - Implementation by FY 2000*

- Complete implementation of vitrification of nitric acid evaporator bottoms.
- Continue electrolytic decontamination of gloveboxes for upgrade projects.
- Continue support of closed-loop recycle for TA-55 hydrochloric acid process line.
- Develop out-year projects for TRU waste minimization.

### 3.1.8 Performance measures and goals

The most important performance measure will be the volume of TRU waste generated by the major facilities. However, this measure will have to be adjusted for the increased mission requirements for both workoff of plutonium residues in response to DNFSB 94-1, and for stockpile stewardship activities, especially pit rebuilding.

Development of underlying measures of waste-generating activity is underway, and will be completed in FY 1998. These measures may include such things as number of Material Accountability and Surveillance System (MASS) transactions, and will be a necessary precursor to finalizing the adjusted volume for comparison. Other measures of operational activity will be developed for other waste streams. The waste volumes projected in the DOE/EM Ten Year Plan are significantly above those generated in the last few years. A successful TRU/MTRU waste minimization program will result in rates at the end of the ten year period below the CY 1993 baseline, in spite of the threefold increase in generating activities.

In addition, the funding dedicated by the facilities to waste minimization projects will be tracked, as a measure of the incorporation of waste minimization as a process improvement criterion in the operation of TRU/MTRU waste-generating facilities. Completion dates of major projects proposed and funded will also be tracked as measures of commitment of the funding sources to project implementation, and of actual investment return for pollution prevention projects.

## *3.2 MLLW minimization*

### 3.2.1 Background

Mixed waste is any waste containing both hazardous and source, special nuclear, or by-product materials. For a mixed waste to be considered mixed low-level waste, it must meet the definition of low level waste. Thus, MLLW contains both radioactive and RCRA or TSCA hazardous components, including any radioactive material contaminated with polychlorinated biphenyls (PCBs) in which the transuranic element content contributes less than 100 nCi/gm.

As MLLW contains radioactive components, it is regulated by the DOE. As it contains RCRA and TSCA components, it is also regulated by the State of New Mexico through the site's operating permit and FFCO/STP (NMED, 1995). The FFCO/STP lists approximately 600 $m^3$ of legacy MLLW which the Laboratory intends to treat over the next seven years. A minimal amount of secondary waste is anticipated from disposing of this legacy.

Up to 15% of non-MLLW are managed by the Laboratory at the same level of environmental protection as MLLW. This is typically liquid non-RCRA LLW which, for either operational or regulatory reasons, does not meet the waste acceptance criteria of the RLWTF and must be specially processed.

MLLW is accumulated at the point of generation, then transported to the MLLW storage and characterization area at TA-54. MLLW is characterized, consolidated (or bulked), certified, and shipped off-site to commercial disposal facilities by the Laboratory's Solid Waste Disposal Operation (EM/SWO).

MLLW costs an average of $45,000/$m^3$ to characterize, treat, and dispose of. EM/SWO is spending $5.0 million for all MLLW management in FY 1997. The total MLLW budget covers both legacy and newly generated waste costs. If all base program costs are assigned to the anticipated newly generated volume for FY 1997, the costs would be ~$70,000/ $m^3$. The assignment of program management, waste storage and project controls costs between legacy and newly generated wastes is difficult, but would place the unit cost between $50,000 and $70,000.

After legacy workoff, unit costs may well rise above this value if waste minimization efforts are successful and base costs are not reduced. Waste generating groups may spend an additional 10-25% of the above unit costs processing and transporting

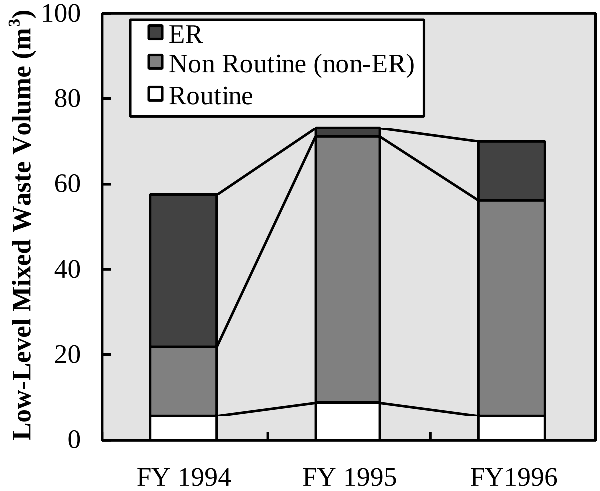



**Figure 3-4: MLLW waste volumes by fiscal year**

MLLW to TA-54. However, the cost of MLLW streams can vary by an order of magnitude depending on the type and volume of waste in the stream and the characterization requirements.

The DOE/EM Ten Year Plan shows non-ER MLLW volumes increasing in the next few years, then decreasing steadily as a consequence of proposed upstream treatment projects (Table 3-3).

### 3.2.2 Waste streams descriptions

The systems approach to MLLW divides the waste streams into routine (6 $m^3$/year) and nonroutine (60 $m^3$/year) (See Table 3-4 and Figure 3-4). Approximately 87% of routine wastes are research and production operations materials and chemicals from Stockpile Stewardship and Management program activities. Spent chemicals are produced in milliliter to liter quantities that are consolidated into 100 liter quantities before shipment off-site. Lead components that are routinely contaminated with depleted uranium or plutonium are sent off-site for encapsulation and disposal. Activated fluorescent lights are currently held on site.

**Table 3-3: Actual and anticipated MLLW Volumes (in m$^3$)**

| Fiscal Year | Non-ER Waste Volume | ER Project Volume |
|---|---|---|
| 1996* | 65.2 | 13.3 |
| 1997* | 74.5 | 275.8 |
| 1998* | 74.5 | 404.1 |
| 1999 | 71.5 | 368.8 |
| 2000 | 57.5 | 339.9 |
| 2001 | 43.5 | 339.9 |
| 2002 | 35.5 | 339.9 |
| 2003 | 39.3 | 339.9 |
| 2004 | 35.3 | 339.9 |
| 2005 | 27.3 | 339.9 |
| 2006 | 23.3 | 112.2 |
| **Total** | **547.4** | **3,213.6** |

FY 1996 waste volume is actual volume
Projections are from DOE/EM Ten Year Plan, Rev. 1
* newly generated FY 1996 – 1998 MLLW is considered legacy waste.

Nonroutine wastes are further divided into non-ER and ER waste streams. Non-ER wastes include all hazardous materials removed from Radiological Controlled Areas. These “suspect” MLLWs include circuit boards (lead solder) from electronic equipment, pipes with lead solder joints, PCB oil filled ballasts, and fluorescent lights. Where knowledge of process or radiological surveying can provide assurance that no radioactive contamination exists, these materials are released in accordance with DOE Order 5400.5 (DOE, 1993), without being declared waste. Non-ER wastes also include one time disposal of large pieces of equipment (for example, gloveboxes), activated or contaminated lead shielding, and objects with both lead paint and radioactive contamination. This stream accounts for 70% of non-ER nonroutine waste.

**Table 3-4: MLLW waste volumes (m$^3$) by Fiscal Year (1994-1996)**

| Year | 1994 | 1995 | 1996 |
|---|---|---|---|
| **Routine** | 5.54 | 8.70 | 5.64 |
| **Nonroutine, non-ER** | 16.34 | 62.28 | 50.74 |
| **ER** | 35.36 | 1.90 | 13.33 |
| **Total** | 57.24 | 72.88 | 69.71 |

ER wastes are predominantly soils and debris from removal actions. D&D operations produce small amounts of waste similar to non-ER wastes. However, the D&D team has been very successful segregating and reducing the volume of MLLW and consequently is not a significant MLLW generator.

As shown in Table 3-4 and Figure 3-4, routine MLLW generation has been less than 10 m$^3$ for the past few years. Nonroutine, non-ER waste volumes appear to be increasing dramatically due to facility upgrades necessary for the Stockpile Management mission. Nonroutine ER waste volumes fluctuate in response to the scheduling of individual sites being remedied and the amount of funding available for waste minimization.

### 3.2.3 Participating facilities

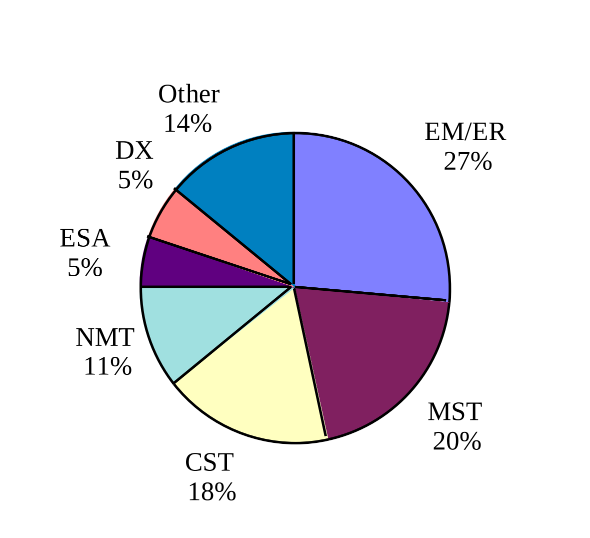
For calendar year 1996, the MLLW produced, by division, is shown in Figure 3-5. A major success of the past four years has been NMT division’s reduction of both MLLW and MTRU. This has been accomplished though process modification to avoid generating MLLW and through completing processes so that the hazardous components are removed. NMT has implemented a program to modify plutonium processes being transferred from Rocky Flats so that a minimum of MLLW is produced.

CST Division MLLW is primarily small quantities of many different spent research chemicals. Dynamic Experimentation (DX) Division MLLW is primarily depleted uranium contaminated lead. Materials Science and Technology (MST) Division MLLW is a combination of spent plating baths and spent research chemicals.

### 3.2.4 Strategy and current targets

The Environmental Stewardship Office is developing a system model for MLLW to identify the highest priority, highest return on investment waste streams. Best systems solutions will be identified and implemented to eliminate these waste streams. Based on preliminary results, five waste-minimizing upstream treatment projects are proposed in the DOE/EM Ten Year Plan – these will reduce the volume of newly-generated MLLW by treating it at

**Figure 3-5: MLLW by Division for CY 1996**




EM – Environmental Management Program
MST – Material Science & Technology Division
CST – Chemical Science & Technology Division
NMT – Nuclear Materials Technology Division
ESA – Engineering Sciences & Applications Division
DX – Dynamic Experimentation Division

the point of generation. Also, NMT division has identified two waste minimization requirements and solutions. Further the ER waste minimization plan has identified sorting and segregation of soils and decontamination of MLLW building debris as high priority solutions. The upstream treatment projects include:

- *Semivolatile Extraction Waste Minimization*: This project will provide upgrades to semivolatile extraction equipment in the CMR building, reducing the amount of waste currently generated by 75%. This extraction is necessary to analyze the increasing number of plutonium samples generated by both the Stockpile Management Program and the ER Project. With the upgraded equipment sample handling, energy savings, glovebox space, glovebox support waste, and stack emissions of solvents will also be reduced. Life cycle savings is estimated at $559,300 through FY 2002 when 1.25 $m^3$ of routine MLLW will be avoided annually.
- *Electrochemical Decontamination of Hazardous and Mixed Wastes*: A portable bench-top electrochemical system has been developed and demonstrated with funding from the DOE/HQ Office of Science and Technology (EM-50). This process can inexpensively recover RCRA metals and other hazardous components from mainly routine MLLW at the point of generation. An estimated 5 $m^3$ of MLLW will be avoided annually.
- *Uranium Metal Machine Waste*: Uranium metal fines and turnings from machine operations are pyrophoric. They are processed as MLLW and are no longer accepted at TA-54. This project is currently considering remelting and recycling these uranium turnings and fines, as well as several other options.
- *Stabilization of Non-Compliant Liquid Low-Level Wastes:* As much as 15% of mainly routine wastes managed at the Laboratory do not meet the waste acceptance criteria of the RLWTF at TA-50 – these are managed as MLLW. This project will demonstrate the stabilization and disposal of these wastes as LLW solids.
- *Generator Treatment of Aqueous MLLW* - RCRA allows for generator treatment of aqueous wastes at satellite and less-than-90-day waste accumulation areas without a permit. Generators can process out the hazardous components, and the resultant solutions can be discharged to the RLWTF. Any solids may be disposed of as LLW at TA-54, Area G, at a significantly lower cost. These wastes are mainly routine.

*Process improvement programs at TA-55:* Waste minimization solutions include:

1. Recycling of cleaning solvents and use of a single solvent for cleaning and measuring the density of plutonium parts, which will reduce the volume of plutonium contaminated solvents produced.
2. Substitution of supercritical $CO_2$ as the cleaning agent for plutonium pits, which will avoid plutonium contaminated organic cleaning solvents.

Once the MLLW model is complete, waste minimization strategies will be reviewed and updated.

### 3.2.5 Immediate, near-term, and out-year activities

*Immediate Priority - Implementation by FY 1998*

- Complete MLLW analysis and model.
- Identify priority waste streams for source reduction opportunities.
- Develop and broker waste minimization projects.
- Begin recycling of uranium metal machine waste.
- Initiate electrochemical decontamination of hazardous and mixed wastes.

*Near-Term Priority - Implementation by FY 1999*

- Initiate semivolatile extraction waste minimization.

*Out-year Priority - Implementation by FY 2000*

- Commence stabilization of non-compliant liquid low-level wastes.
- Initiate generator treatment of aqueous MLLW.
- Complete implementation of supercritical $CO_2$ cleaning of plutonium pits.

### 3.2.6 Performance measures and goals

The DOE has set goals for the prevention of pollution through reduction in the volume of waste generated by routine operations, and through affirmative procurement and recycling for all operations. For routine MLLW, the 1993 level was 12.32 $m^3$. To meet the DOE goal, the routine MLLW volume cannot exceed 6.16 $m^3$ by the year 1999. Waste minimization and other upstream treatment projects will reduce the expected total generation of routine MLLW by >40% over volumes projected in the DOE/EM Ten Year Plan. Additional waste avoidance is anticipated from waste minimization projects yet to be identified. Without these waste minimization improvements, the MLLW generation will increase by 10-15% from increased mission activities.

## *3.3 LLW minimization*

### 3.3.1 Background

Low-level radioactive waste (LLW) is defined in DOE Order 5820.2A (DOE, 1988) as waste that contains radioactivity and is not classified as high-level waste, transuranic waste, or spent nuclear fuel or II(e)2 byproducts material (for example, uranium or thorium mill tailings). Test specimens of fissionable material irradiated for research and development only and not for the production of power or plutonium may be classified as low-level waste, provided that the activity of transuranic elements is less than 100 nCi/g of waste.

Solid LLW generated by the Laboratory's operating divisions is characterized and packaged for disposal at the on-site LLW disposal facility at TA 54, Area G. LLW minimization strategies are intended to reduce the environmental impacts associated with LLW operations and waste disposal by reducing the amount of LLW generated and/or minimizing the volume of LLW that will require storage or disposal on-site.

LLW minimization is driven by the requirements of DOE Order 5820.2A (DOE, 1988), the limited capacity of the on-site disposal facility, and other Federal and DOE regulations. A recent analysis of the LLW Landfill at TA-54, Area G indicates that at planned disposal rates, the current pits will be filled to capacity during FY 2000. Construction of additional landfill pits depends on receiving authority for new pits in the development area. Such action is strongly opposed by the neighboring San Ildefonso Pueblo and may not be approved for five or more years. According to the DOE/EM Ten Year Plan, waste volumes will vary significantly, even with the current waste minimization efforts and proposed upstream treatment projects (Table 3-5).

Based on FY 1996 Area G operating costs, LLW debris costs an average of \$1,575/$m^3$ to dispose of on-site. LLW soils cost \$425/ $m^3$ to dispose of (soils are less expensive as soil is necessary for the burial of debris in the pits). Area G operating costs are very inelastic; average per unit volume rates should decrease as volumes increase. However, these rates do not include the cost of gaining access to development area landfill space.

Based on transport, packaging, and disposal costs, off-site disposal is estimated to be equivalent to or more expensive than on-site disposal. Some high-activity LLW is not shippable and can only be disposed of on-site (such as LANSCE beam stops). In addition to treatment, storage, and disposal costs, the LLW generator pays an additional 10-25% for

**Table 3-5: Actual and anticipated LLW volumes ($m^3$)**

| Fiscal Year | Non-ER Waste Volume | ER Project Waste Volume |
|---|---|---|
| 1996 | 1,345 | 2,615 |
| 1997 | 3,928 | 2,106 |
| 1998 | 5,541 | 2,106 |
| 1999 | 5,541 | 2,106 |
| 2000 | 5,591 | 2,106 |
| 2001 | 5,591 | 2,106 |
| 2002 | 3,978 | 2,106 |
| 2003 | 3,978 | 2,106 |
| 2004 | 5,123 | 2,106 |
| 2005 | 5,123 | 2,106 |
| 2006 | 7,468 | 2,106 |
| **Total** | **53,207** | **23,675** |

FY 1996 waste volume is actual volume
Projections are from DOE/EM Ten Year Plan, Rev. 1

LLW characterization, administrative processing, and transport.

Liquid LLW is typically generated at the same facilities that generate solid LLW. It is transferred through a system of pipes and tanker trucks to the RLWTF at Building 1 of TA-50. Here the radioactive component is concentrated to a sludge which is dewatered and disposed of as LLW. A portion of the waste is solidified in concrete and stored as TRU waste. The remaining liquid is discharged through a permitted outfall. The RLWTF can process 20 million liters per year. Its operating budget is ~ $8,000,000 per year. The cost of maintaining a radioactive liquid treatment capability is independent of volume for volumes less than the current 20 million liter capacity. Because of this inelasticity, liquid LLW avoidance has not been a priority and is not discussed in this plan.

### 3.3.2 Waste stream description

LLW is generated in RCAs and at D&D and ER sites. In most RCAs only the potential for contamination is present. While people can be easily monitored in and out of these facilities, supplies and equipment cannot. Anything that enters an RCA becomes suspect LLW when it leaves. Material can be released from an RCA either through knowledge of process (*i.e.,*. it is known the material never had an opportunity to become contaminated) or a radiological survey has determined it to be uncontaminated according to the limits of DOE Order 5400.5 (DOE, 1993). The free release radioactivity limit for alpha-contaminated materials is well below the resolution of simple surveying detectors. Material potentially contaminated with alpha emitters is disposed of as LLW. Most Laboratory RCAs have the potential for alpha contamination (primarily due to plutonium).

The Laboratory's annual LLW waste generation rate increased from ~1,910 $m^3$ in FY 1994, to ~3,090 $m^3$ in FY 1995, and to ~3,960 $m^3$ in FY 1996, showing a three year average of 2,990 $m^3$/year (Table 3-6 and Figure 3-6). LLW generation data is from the Waste Management Data Base. These annual generation rates include waste from routine operations (also referred to as "normal) and from nonroutine (or "off-normal") operations, including ER Project wastes.

Since 1994, the LLW contributed from ER projects has increased to become a dominant waste source. This results from ER projects progressing from investigation and characterization phases to remediation activities, as well as increasing D&D activities. This trend is expected to continue during the next five years, as ER remediation projects continue.

Excluding ER sources, the LLW generation at the Laboratory declined during the past three years, with 1,800 $m^3$ generated in FY 1994, 1,910 $m^3$ in FY 1995, and 1,340 $m^3$ in FY 1996; producing a three year average of 1,680 $m^3$/year. Of these totals, the percentage of all LLW contributed by routine operations showed a decline, representing 90% of the total in FY 1994, 45% in FY 1995, and

**Table 3-6: LLW volume ($m^3$) by Fiscal Year (1994-1996)**

| LLW | 1994 | 1995 | 1996 |
|---|---|---|---|
| **Routine** | 1,729 | 1,396 | 524 |
| **Non Routine (non-ER)** | 71 | 512 | 821 |
| **ER** | 112 | 1,186 | 2,615 |
| **Total** | **1,912** | **3,094** | **3,960** |

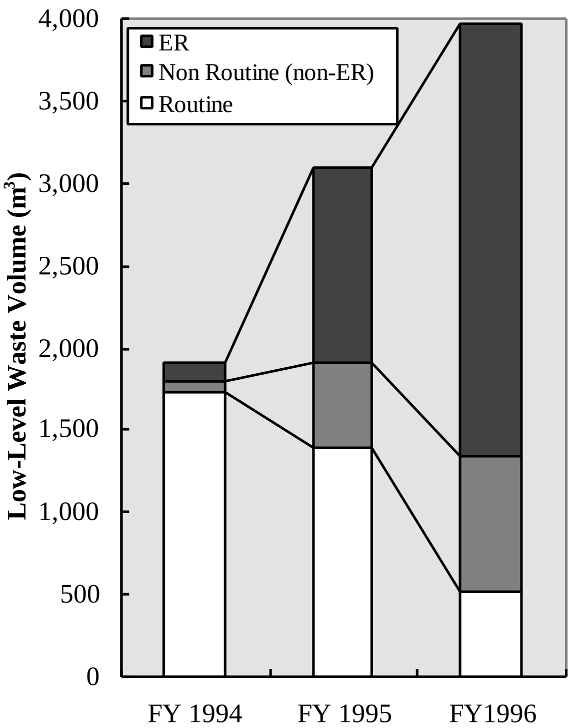



**Figure 3-6: Low-level waste volume (m$^3$) by Fiscal Year (1994-1996)**

13% in FY 1996. The non-ER, nonroutine wastes contributed the balance. Nonroutine (non-ER) wastes typically include material from inventory cleanout, scrap metal, debris and equipment from building upgrades or transitions and other operations that take place in the facility but are not part of the normal Laboratory operations.

LLW waste generation rates from routine operations may increase during the next ten years, as reflected in the DOE/EM Ten Year Plan waste projections shown in Table 3-5, because missions are ramping up at the TA–53 (LANSCE), and Sigma facilities. Similarly, waste from nonroutine operations is expected to increase as construction, reconfiguration, and upgrades are planned for the major radioactive waste-generating facilities at CMR, TA–55, and Sigma.

Figure 3-7 shows the percentage of low-level waste generated, by division, for CY 1996. Excluding the ER Project, the major waste generating organizations operate the Laboratory's five key radiation facilities: the CMR facility, TA–53 (accelerator facility), TA–55 (plutonium facility), TA–48 (radiochemistry site and medical isotope program), and the Sigma facility. Historically, these five facilities are recognized as the major generators of LLW and the DOE/EM Ten Year Plan waste projections show that they will remain primary generators, with LLW from TA–53 and Sigma facilities expected to increase.

The CMR facility (located at TA–3) has served as a primary special nuclear materials analytical laboratory since the early 1950s. LLW generated from routine operations at the CMR facility consists of contaminated and potentially contaminated laboratory equipment, PPE, and general laboratory trash products. Radionuclides present in CMR waste can include any present at the Laboratory. However, most waste items contain either fission products (primarily $^{137}$Cs and $^{125}$Sb) or plutonium and its decay products ($^{238}$Pu, $^{239}$Pu, $^{240}$Pu, $^{241}$Pu, $^{241}$Am, $^{237}$Np, $^{233}$Pa, and $^{237}$U – Soukup and Erpenbeck, 1996). The CMR facility is currently undergoing significant construction reconfiguration. These activities will continue to produce high volumes of nonroutine LLW, including construction and demolition debris (for example, electrical con-

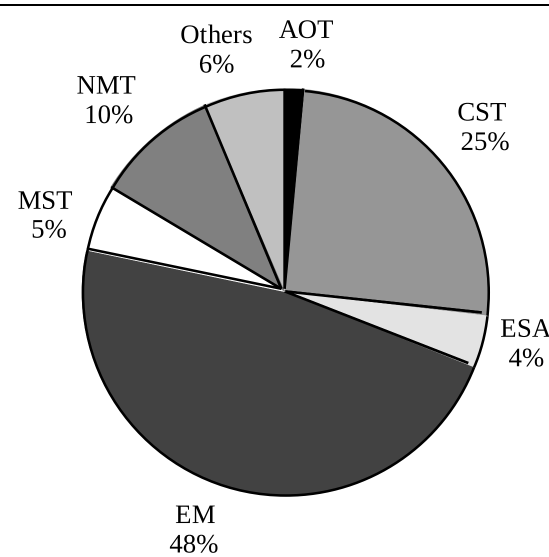



**Figure 3-7: Major generators of LLW, CY 1996, as percentage, by division:**

EM –Environmental Management Program
CST – Chemical Science & Technology Division
NMT – Nuclear Materials & Technology Division
MST – Materials Science & Technology Division
ESA – Engineering Sciences & Applications Division
AOT – Accelerator Operations & Technology Division

duit, water pipes, and ventilation ducts), PPE, decontamination wastes, and other waste types.

TA–55 is the Laboratory's Plutonium Processing Facility, which includes seventy structures and over 300 gloveboxes for handling plutonium, uranium, and other nuclear materials. LLW generated at TA–55 is primarily contaminated with Pu and its decay products, most importantly $^{241}$Am. Most waste items are compactible room trash (for example, small lab items, PPE, and paper) or non-compactible building debris (wood, plastic, metal, rubber, rags, equipment, and other items).

TA–53 includes the Laboratory's high energy particle accelerator facility. The majority of LLW is contaminated with activation and spallation products. Waste packages commonly contain low-density compactible trash, contaminated with gamma-emitting activation products, including $^{7}$Be, $^{56}$Co, $^{60}$Co, and $^{54}$Mn. These strong gamma emitters are readily detectable with available instruments.

TA–48 facilities are used for analytical and physical chemistry in the study of nuclear properties of radioactive materials, and for the preparation of medical isotopes. Waste originating in the TA–48 hot cells accounts for a high percentage of the total LLW and it is typically compactible trash contaminated with radionuclides identical to those in TA–53 waste.

The Sigma facility (located at TA–3) houses over seventy processing technologies including metal melting and casting, machining and grinding, mechanical metallurgy, physical metallurgy (metallography), electrochemistry (electroplating), beryllium processing, and others. LLW from the Sigma facility includes compactible LLW trash, contaminated wastewater, spend radioactive materials, used equipment, and process sludges.

The majority of LLW generated by the Laboratory's key facilities is in solid form, with liquid and gas LLW forms representing only 1 to 4% of the total LLW during the past three years. The estimate for liquid and gas LLW is based on the volume of LLW that is handled and manifested by TA-54. Liquid LLW that is piped directly to TA-50 is not considered in this discussion.

The solid LLW streams may be categorized into the following groups or waste forms, as shown in Table 3-7. The vast majority of waste packages generated from routine operations are a mixture of materials. Typical descriptions include "miscellaneous scrap metal, plastic, wire, rags, cables, and laboratory trash." These non-segregated packages are grouped as non-compactible, non-combustible and make up the highest percentage of non-ER waste forms. Compactible waste include packages that were segregated and do not include debris, scrap,

**Table 3-7: Major LLW groups**

| Group or Waste | % of Volume[1] |
|---|---|
| ER Soil and Building Debris | |
| Soil (20% used as fill at Area G) | 35 |
| Building Debris | 5 |
| Investigative derived waste (PPE, samples, site control materials, and decontamination wastes) | <1 |
| Subtotal | 42 |
| Compactible | |
| Plastics and paper products | 9 |
| PPE (gloves, booties, *etc.*), rags, and kimwipes | 7 |
| Other general laboratory trash | 4 |
| Subtotal | 20 |
| Non Compactible – Non Combustible | |
| Mixtures – scrap metal, wire, cables, glass, lab trash, and other cellulosic wastes | 14 |
| Debris (non-ER) pipe, conduit, tarps, fittings, valves, tubing, and tools | 2 |
| Subtotal | 16 |
| Scrap Metal (typically from rebuilding and modifications) | 16 |
| LLW Asbestos (including piping, ventilation and other debris containing asbestos) | 3 |
| Total | 97 |

[1] Based on historical information provided by the TA–54 waste management facilities and databases, including the Summary of Waste Projections from the Site Wide Environmental Impact Statement and the current vision of LLW management strategy

laboratory equipment or chemical products. These waste packages typically include PPE (gloves, coveralls, booties), rags, kimwipes, plastics and paper products, and are typically described as laboratory trash.

The highest priority waste streams are nonroutine wastes from ER projects (including soil and debris) and non-ER upgrades, cleanout/rebuild, major construction and decommissioning projects. As outlined earlier, the last three years have shown that nonroutine wastes are the largest waste streams and will continue to exceed wastes from routine operations. This is echoed in the above profile, where ER soil, building debris, scrap metal, noncompactible debris, and asbestos make up almost 63% of the waste. Other major waste streams from nonroutine operations include PPE, contaminated equipment and tools, decontamination fluids, and, possibly, treatment wastes.

Waste from routine operations may still be a significant source because of the expected increase in production at the radioactive facilities. The priority wastes from routine operations are the low density, compactible wastes that include laboratory trash and PPE, such as papers, plastic, gloves, booties, rags, and others. As shown in the profile, this compactible waste may represent up to 20% of the total waste stream.

The low density cellulosic wastes (typically from TA–48 and TA–53) are a specific target waste stream for reduction. Waste packages from these facilities tend to be low-density compactible trash, contaminated with gamma-emitting activation products. Because of the nature of the contamination at TA–48 and TA–53 (that is, fixed contamination of target and beam-line materials), it is expected that the low density cellulosic waste is probably not contaminated and can be easily surveyed for release.

### 3.3.3 Recent accomplishments

Implementation of LLW reduction projects requires consideration of safety impacts, regulatory impacts and impacts to negotiated schedules, especially for ER related projects. Waste reduction activities for routine operational waste have focused on implementing and improving materials segregation and characterization programs to verify that low-density LLW packages can be cleared for free release; the use of launderable/reusable PPE; and implementation of DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE, 1993) and Laboratory Standard 105-05, *Removing Waste from Radiological Control Areas* (LANL, 1996c) for free release of minimally contaminated materials.

Characterization and segregation programs such as Green Is Clean, Waste Acceptance for Nonradioactive Disposal (WAND), and LLW box-counters (including MADAM - Multiple-Axis Dual Assay Measurement) are in various stages of implementation or proposal. These will be used to target reduction of the routine low-density cellulosic waste from TA–48 and TA–53. In addition, they can be used to reduce waste from upgrade projects at CMR and TA–55, if appropriate.

The CMR and TA–55 facilities are among the Laboratory's leaders in waste characterization capabilities. The Laboratory intends to expand the waste characterization procedures in these facilities to provide a systematic process for sorting, surveying and release of "clean" materials. However, the waste from CMR and TA–55 tends to consist of higher density materials such as building debris, which are more difficult to survey. Furthermore, because of the widespread contamination in these facilities, it will be difficult to survey and release many materials.

DOE/Headquarters (DOE/HQ) High ROI Project funding has been used to reduce LLW generated in RCAs by reducing the area of RCAs at the Laboratory, as well as by increasing the volume of waste from RCAs that can be released for non-radioactive disposal through decontamination and radiological surveying. The goal for area reduction was 50,000 $ft^2$. The project surpassed this goal by reducing RCAs by 150,000 $ft^2$. Area reductions included:

- 133,000 $ft^2$ of RCA space at the Sigma facility, where large amounts of stored equipment were considered suspect LLW,
- 12,000 $ft^2$ at the CMR facility, downgraded from a high contamination area to a radiological buffer area, which allowed for free re-

lease of waste materials based on surveys proving that radiological contamination was not present,

- 3,500 $ft^2$ at TA-35, TA-48, and TA-50 decontaminated,
- 15,000 $ft^2$ at CMR released through decontamination and radiological surveys.

DOE/HQ High ROI Project funding has also been used to reduce the volume of scrap metal classified as LLW through decontamination and recycling processes. The goal was set to reduce low-level radioactive scrap metal by 2,400 $m^3$. At this time, almost 2,000 $m^3$ scrap metal has been decontaminated and released or reused, thus removing it from the LLW classification. A cost/benefit analysis determined that melting the metal for reuse is not cost effective.

Attention has also been paid to recycling and waste avoidance opportunities in the engineering design, specification, and standard work practices for upcoming ER projects, facility upgrades and construction. Since FY 1995, several projects have been initiated to focus on minimizing the high priority, nonroutine waste streams from ER, decommissioning, and construction activities. These projects have been successful in increasing awareness and application of waste minimization and pollution prevention techniques within ER, decommissioning projects, and construction projects – the largest sources of LLW soil, debris, and scrap metal. These high volume waste streams (LLW soil, debris, and scrap metal) have been minimized through planning and implementation of contamination avoidance, improved characterization, sorting and segregation procedures, treatment and decontamination methods that facilitate recycling or release, and closure plans that leave the contaminated media in place.

The ER Project published pollution prevention awareness plans for FY 1996 (LANL, 1996a) and FY 1997 (LANL, 1996b) to document ER waste reduction strategies and waste avoidance successes. Similarly, recent construction upgrades projects at the CMR building and other decommissioning projects have written pollution prevention plans as part of the project documents.

Pollution prevention resources are already part of the ER team planning remediation projects at TA–16; and waste minimization plans are in place for TA-55 and CMR upgrades projects. Many of the projects described in those plan are expected to be implemented as funding becomes available.

### 3.3.4 Strategy and current targets

Strategies have been developed for some of the main waste types described above, as well as for continuation of cross-cutting waste minimization efforts such as the RCA reduction program and the increased application of DOE Order 5400.5 (DOE, 1993), and Laboratory Standard 105-05 LANL, 1996c), so as to increase the amount of material that may be released from RCAs for beneficial reuse or recycling.

Cross cutting strategies to minimize the large volume of ER soil and building debris will include systematic efforts to integrated waste minimization into the planning and engineering design phases of the ER, construction, or decommissioning project. Incorporating waste minimization strategies during planning phases is one of the few opportunities for source reduction of LLW soil and debris. Well defined agreements with regulators and stakeholders regarding land-use scenarios, cleanup performance standards, and risk and pathway scenarios can be highly effective in avoiding or reducing primary wastes (for example soil and building debris) and secondary wastes.

Other waste minimization and pollution prevention strategies that will be used during the ER and construction planning phases include: incorporating practices into budgets; inserting language into project plans, specifications, and contractor documents; coordinating with design engineers and construction teams during conceptual and preliminary design stages; negotiating with regulators to allow treatment options that generate little secondary waste; and developing sampling strategies that limit the number of samples.

Reduction of RCAs will be encouraged across the Laboratory, through cost/benefit analysis of the recent reductions, and through communication of the pollution prevention successes realized through this program. Additional reductions are continuing through the end of the project. A final report will include lessons learned and recommendations for continued implementation.

*ER Soil*
Strategies for reducing or avoiding LLW soil from ER projects include: incorporating waste minimization during the planning and negotiations phases (as discussed above); the increased use of risk-based and on-site clean-up strategies that may allow media to remain in place; and improved characterization and segregation technologies. On-site strategies will include bioremediation and heap leaching for removal of radioactive materials from soils; and improved segregation techniques will include segmented gate systems to sort and segregate heterogeneous contaminated soils.

*Debris*
Strategies for reducing LLW debris from construction, and D&D activities include: incorporating waste minimization during the planning and engineering phases; use of on-site and risk-based clean up strategies that may allow media to remain in place; improved segregation to minimize cross contamination and facilitate decontamination and recycling; innovative decontamination technologies; and increased application of DOE 5400.5 (DOE, 1993), and Lab Standard 105-05 (LANL, 1996c), to improve the release of materials. D&D and construction projects will rely on guidance from the *Handbook for Controlling Release for Reuse or Recycling of Property Containing Residual Radioactive Material* (Argonne National Laboratory [ANL], draft, 1997). Finally, the use of mechanical equipment for volume reduction (for example, shears and crushers) will be considered.

*Compactible wastes*
Improved sorting, characterization and segregation programs such as Green Is Clean, WAND, MADAM, and LLW box-counters will be used to reduce this waste stream. These waste streams will also be controlled at the source through inventory control and procurement strategies (also know as pollution prevention procurement). These strategies will focus on limiting the types of materials that are purchased and used in RCAs (such as purchasing only materials that are consistent with available compacting and treatment facilities). PPE, kimwipes, rags, plastics and paper waste will be further reduced through the use of leased contamination barriers and launderable/reusable PPE. Mechanical compactors may also be used, at the place of generation or at the TA–54 waste management facility, to reduce volume prior to disposal.

*Non-compactible wastes*
The non-compactible waste stream includes mixtures of compactible materials that have not been properly segregated from miscellaneous scrap metal, wire, glass, and other materials. Improved sorting and segregation requirements can substantially reduce this waste stream, and the sorted compactible wastes (expected to be the majority of the waste) may then be handled as described above for compactible wastes. The true non-compactible waste types (scrap metal, wire, glass, cables, and conduit) may be reduced through Green Is Clean procedures, improved decontamination, and application of Laboratory Standard 105-05 (LANL, 1996c). These waste streams may also be reduced through inventory control and procurement strategies that limit the purchase and use of these materials in RCAs. Large volume items will be reduced in volume first by considering dismantling and segregation, and decontamination options. The use of shears, cutters, or crushers will be considered in some cases.

*Scrap metal*
The Environmental Stewardship Office is working with EM/SWO to construct and operate a centralized facility for the decontamination of scrap metal for free release. A cost/benefit analysis concluded that such a facility would be effective and efficient at minimizing the LLW volumes. Based on current plans for staff and funding, this facility will be able to process and release approximately 1,000 $m^3$ scrap metal per year.

*LLW Asbestos:*
Pilot testing of the MADAM box counter system is planned to segregate and release LLW asbestos for disposal as hazardous waste.

### 3.3.5 Immediate, near-term, and out-year activities

*Immediate Priorities - Implementation by FY 1998*

- Complete evaluation of LLW data and specify routine waste forms to be targeted for waste reduction.
- Complete implementation of Green Is Clean program at TA-55, TA-48, and TA-53.
- Identify and test improved segregation procedures to eliminate mixtures of compactible and non-compactible wastes.

*Near Term Priorities - Implementation by FY 1999*

- Expand use of ER soils as fill for TA–54, Area G LLW disposal facility.
- Implement waste reduction strategies from DOE 5400.5 and Lab Standard 105-05 for free release of minimally contaminated materials.
- Standardize use of launderable PPE.
- Implement improved segregation procedures to eliminate mixtures of compactible and non-compactible wastes.
- Implement material substitution and inventory control efforts in TA-55 and CMR.
- Expand and improve Green Is Clean and monitoring programs, using the WAND and MADAM systems.
- Pilot test MADAM box counter systems to segregate and release LLW asbestos.
- Identify and fund pollution prevention projects to reduce generation of LLW soil from ER projects.
- Identify and fund pollution prevention projects that decontaminate and release contaminated equipment and building debris (targeting upgrade projects at TA–55 and CMR).
- Integrate recycling and waste avoidance opportunities in the engineering design, specification, and standard work practices for upcoming ER projects, facility upgrades and construction.

*Out year - Implementation by FY 2000*

- Procure use of size reduction equipment, for use at TA–54 and for use at construction/demolition projects

#### 3.3.6 Performance measures and goals

The primary performance measures will be the volume of routine LLW waste generated by the major facilities and the volume of LLW avoided during nonroutine operations. LLW avoidance will be tracked and documented through quarterly reports (ESO to DOE/AL), The DOE Annual Pollution Prevention Report, the annual ER Waste Minimization Awareness plans documenting waste minimization accomplishments, and ongoing interaction with generators. The routine LLW measure will have to be adjusted for the increased mission requirements. In addition, the funding dedicated by the facilities to waste minimization projects will be tracked.

### *3.4 Hazardous waste minimization*

#### 3.4.1 Background

Hazardous waste, as defined by the Resource Conservation and Recovery Act (RCRA - EPA 1976), and 40 CFR 261.3 (EPA, 1989), and adopted by the State of New Mexico Environment Department (NMED), is any solid waste which is generally hazardous if it is not specifically excluded from regulation as a hazardous waste; is listed in the regulations as a hazardous waste; exhibits any of the defined characteristics of hazardous waste (ignitability, corrosivity, reactivity, or toxicity); or is a mixture of solid waste and hazardous waste.

The Laboratory produces routine and nonroutine hazardous waste as a by-product of mission operations. Hazardous waste commonly generated at the Laboratory includes many types of laboratory research chemicals, solvents, acids, bases, carcinogens, compressed gases, metals, and other solid waste contaminated with hazardous waste. This may include equipment, containers, structures, and other items intended for disposal and contaminated with hazardous waste (for example, compressed gas cylinders). It also includes substances regulated under the Toxic Substance Control Act (TSCA), such as polychlorinated biphenyls (PCBs) and asbestos. Finally, a material is hazardous if it is regulated by the State of New Mexico as required by the New Mexico Solid Waste Act of 1990 (State of New Mexico, 1990) and defined by the most recent New Mexico Solid Waste Management Regulations, 20NMAC 9.1 (NMED, 1994) or current revisions.

In FY 1996, the Laboratory disposed of 8,267$m^3$ of hazardous waste. In FY 1996 the Laboratory spent \$2.5 million, or \$8.17/kg, on non-ER hazardous waste disposal. These costs include Laboratory EM/SWO costs for characterization, bulking, and shipping ($4.77/kg) and off-site disposal contractor costs for disposal ($3.40/kg).

Hazardous wastes managed through EM/SWO are mainly disposed through one of two primary Laboratory sub-contracting operations (Rollins Chempak, Inc. and Chemical Waste Management, Inc.). These primary contractors send waste shipments to recyclers, energy recovery facilities for fuel blending or burning for BTU (British Thermal Unit) recovery, or other licensed vendors as in the case of mercury recovery. The disposal fees are charged back to the Laboratory at commercial rates specific to the disposal circumstance. The actual cost of disposal varies with circumstances, however, the average cost is $8.17/kg.

Not all waste is physically handled at TA–54; some wastes, such as those generated in the ER Project are sent directly off-site from field sites, generally by the truckload, without costly packaging. The Laboratory spent $15 million, or $2.00/kg, for ER Project hazardous waste disposal. ER's primary waste streams are soils and decontamination and rinse waters.

Other direct off-site recycling activities include mercury light bulb recycling, oil recovery for recycling, and silver recovery from photo chemicals. In these cases, the waste is only manifested through TA-54 and not physically handled by the EM/SWO. Hazardous wastes are not generally disposed of or stored on-site, but are shipped off-site or reused through the CHEAPER Program. Gas cylinders which contain hazardous waste, many of which cannot be safely or compliantly shipped to disposal companies, are one exception. In some cases where shipping is possible, the disposal cost is prohibitive, and such hazardous wastes are being stored until an affordable solution is found.

**Table 3-8: Actual and anticipated hazardous waste volumes ($m^3$)**

| Fiscal Year | Non-ER Volumes | ER Project Volumes |
|---|---|---|
| 1996 | 847 | 7,420 |
| 1997 | 928 | 803 |
| 1998 | 983 | 1,140 |
| 1999 | 979 | 1,077 |
| 2000 | 962 | 991 |
| 2001 | 945 | 991 |
| 2002 | 923 | 991 |
| 2003 | 1,314 | 991 |
| 2004 | 1,250 | 991 |
| 2005 | 1,192 | 991 |
| 2006 | 1,140 | 908 |
| **Total** | **11,463** | **17,294** |

FY 1996 value is actual volume
Projections are from DOE/EM Ten Year Plan, Rev. 1

Two Laboratory vulnerabilities result from generation of hazardous waste streams: 1) the national and regional trend toward stricter regulations has commonly led to increased waste costs and a greater possibility for fines or activity moratoria from accidents or compliance failures, and 2) by the nature of these wastes, they have the potential to be a factor in serious accidents.

The DOE/EM Ten Year Plan projection for non-ER hazardous waste generation (Table 3-8) indicates a continuous increase over seven years, with slight decreases after that. This increase is a direct result of the increasing Laboratory Stockpile Stewardship and Management activities. These volumes already include the reductions from upstream treatment projects to identify and minimize the hazardous waste streams.

### 3.4.2 Waste stream description

Most Laboratory activity generates some amount of hazardous waste. Analysis of hazardous waste is accomplished by dividing it into routine, nonroutine (non-ER), and ER categories, and further by dividing it into liquid and solid waste streams. For FY 1996, nonroutine hazardous waste generation comprised 99% of the total waste. ER activities contributed the majority of all nonroutine generation.

Since 1994, as the ER project has increased activities, the percentages of total waste attributable to the ER nonroutine operations has steadily increased, while inversely, the generation of routine operational waste has decreased. The Laboratory's annual ER waste generation increased from ~132 $m^3$ in FY 1994, to ~707 $m^3$ in FY 1995, and to ~7,420 $m^3$ in FY 1996. Conversely, routine waste generation for the same periods was ~337 $m^3$ in FY 1994, ~134 $m^3$

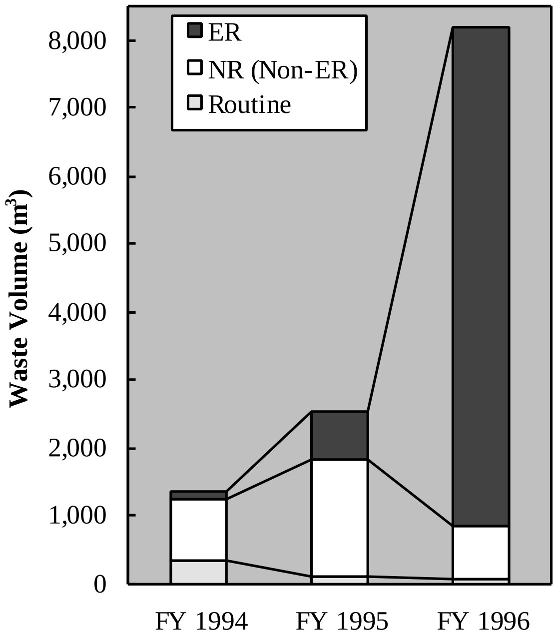



**Figure 3-8: Hazardous Waste generation by Fiscal Year**

in FY 1995, and ~ 91 $m^3$ in FY 1996 (Table 3-9 and Figure 3-8).

Liquid hazardous wastes arise from several types of Laboratory activities including: Johnson Controls Inc. housekeeping activities, byproducts of Laboratory specialty shops (photochemicals and machining coolants), and R&D/production activities (acids, bases, solvents, and chromium solutions).

The ER Project is the largest generator of solid hazardous waste, generating 90% of Fiscal Year 1996 volumes, and 96.5% of the total CY 1996 volume. (ER FY 1996 waste resulted from a removal action at Material Disposition Area P considered anamolously large.) D&D activities are considered part of ER operations. D&D produces contaminated building waste, such as lead soldered pipes, and mercury contaminated components. Non-ER hazardous soils account for 88% of the remaining solid waste, with fluorescent light bulbs accounting for 7% and incinerator ash making up 5% of the remaining identified waste streams, as shown in

, Table 3-11, Figure 3-9, and Figure 3-10.

### 3.4.3 Participating facilities

Figure 3-9 identifies the total volume of waste (both liquid and solid) produced by each major generating division. Figure 3-10 displays the relative volumes without the ER wastes. As ER wastes are disposed of in truckloads, without packaging, these wastes are not as expensive as those produced by JCI and the Laboratory's technical divisions (shown here as other). Note that as a support contractor, JCI handles and reports hazardous wastes from many Stockpile Stewardship and Management activities, therefore, nuclear weapons activity waste comprises a significant fraction of the JCI and other waste categories.

### 3.4.4 Strategy and current targets

and Table 3-11 divide the liquid and solid waste stream into components and rank those components according to their disposal costs. The hazardous waste strategy focuses on the largest present and anticipated waste stream components and tailors a solution for each. In all cases, the pollution prevention hierarchy of prevention recycling or reuse, treatment, and disposal is followed with source elimination being the best and preferred strategy and volume reduction being the least desirable. However, the solution selected must also consider cost, impact on safety, and impact on product performance.

**Table 3-9: Hazardous Waste Generation by Fiscal Year in $m^3$**

| Waste Generator | 1994 | 1995 | 1996 |
|---|---|---|---|
| ER | 132.3 | 706.5 | 7,420.3 |
| NR (NON-ER) | 921.3 | 1,688.9 | 756.1 |
| Routine | 337.1 | 134.5 | 90.7 |
| **Total Waste** | **1,390.7** | **2,529.9** | **8,267.1** |

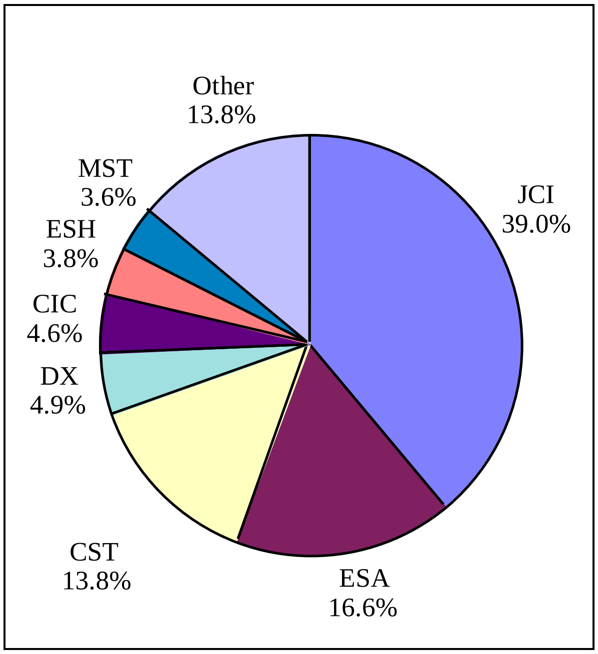



**Figure 3-10: CY 1996 hazardous waste generation by division, excluding ER**

JCI – Johnson Controls, Incorporated
ESA – Engineering Sciences & Applications Division
CST – Chemical Science & Technology Division
DX – Dynamic Experimentation Division
CIC – Computing, Information, & Communications Division
ESH – Environment, Safety, & Health Division
MST – Materials Science & Technology Division

- *Machine coolant*: Experience at Rocky Flats and other large commercial fabrication companies indicates that the life of machining coolant can be extended almost indefinitely through a regime of bacterial inhibitors, viscosity adjustments, and other controls, while continuously measuring the quality of the coolant. An ROI proposal has been funded by DOE/AL to implement this regime at the Laboratory. This should achieve a 75% reduction in this stream within six months. This stream, currently the largest liquid stream, is expected to significantly increase as the Stockpile Stewardship and Management missions produce more components for weapons tests.

- *Oils:* Most oils can be recycled through a commercial vendor rather than being disposed of as hazardous waste. Over the next 12 months the Laboratory will identify oils that can go to the oil recycler and facilitate waste generators using the recycler.

- *Photochemicals:* In the near term (next six months) silver recovery units will be installed to reduce the amount of photochemicals being disposed of as hazardous waste. In the longer term (two years), the Laboratory is converting to digital photography, which will eliminate 80% of this waste stream.

- *Production and Research Laboratory wastes (acids, solvents, hydroxides, organic waste, chromium solution, etc.):* While these wastes are not large today, they are a significant element of the hazardous waste growth expected in the next ten years as the Stockpile Stewardship and Management missions are fully undertaken. These wastes also have the greatest potential for regulatory vulnerability as they are among the most hazardous and are handled in small quantities by a large number

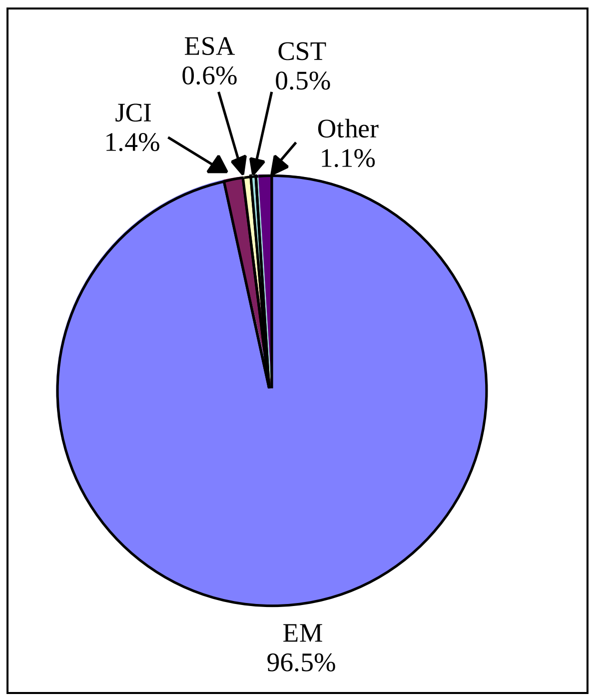



**Figure 3-9: CY 1996 hazardous waste generation by division**

EM – Environmental Management Program
JCI – Johnson Controls, Incorporated
ESA – Engineering Sciences & Applications Division
CST – Chemical Science & Technology Division

of individuals. Solutions for this waste stream component include:

1) providing disposal and hazard information in the procurement system and links to chemical substitution information;
2) developing a procurement channel that enables technical staff to purchase the required quantity of chemical needed, rather than the minimum bulk size sold by present vendors;
3) improving the Laboratory's ownership and accountability system for chemicals so individual researchers dispose of their chemicals when they leave an organization;
4) improving the CHEAPER program by integrating it into the procurement system, moving CHEAPER inventory to TA-54, Area L, and increasing CHEAPER manpower;
5) seeking regulatory permission with the assistance of the Water Quality and Hydrology Group, for sanitary system disposal of low concentration organic chemicals that assist the bacterial operation of the sanitary waste treatment plant, and
6) developing Standard Operating Procedures (SOPs) and Laboratory standards for standard chemical purification and recycle systems that can be used by chemical technicians to recover useful chemicals from reaction products.

- *ER/D&D soils and debris:* The ESO now cofunds a waste minimization coordinator for the ER/D&D programs. ER/D&D must clean up sites which have previously been contaminated. Thus, some waste will inevitably be generated by these actions. Efforts which reduce the ultimate amount of waste generated are not commonly considered source reduction. However, the major waste minimization strategy of the Laboratory's ER project is to gain regulatory approval for solutions that stabilize or contain contaminated materials in place without moving them, and thereby generating waste. Other solutions include:
    - ◊ volume reduction by sorting and segregating waste from uncontaminated soils,
    - ◊ heap leaching contaminated soils to remove the hazardous metal components,
    - ◊ decontamination and recycling of lead, other metal components, and equipment, and *in situ* bioremediation.

**Table 3-10: Major Hazardous Liquid Waste Streams**

| **Major Liquid Waste Streams** | **Vol. ($m^3$)** | **Wgt. (kg)** | **Disposal Cost @ $7.30/kg** | **% of Total Liquids** |
|---|---|---|---|---|
| Machine coolant | 19.9 | 18,664 | 136,246 | 13.42 |
| Oils | 17.6 | 16,080 | 117,385 | 11.56 |
| Photo chemicals | 14.8 | 15,643 | 114,193 | 11.24 |
| Decon water | 17.0 | 14,961 | 109,216 | 10.75 |
| Rain water from Containment Sumps | 12.2 | 13,193 | 96,312 | 9.48 |
| Rinse water | 7.2 | 6,341 | 46,287 | 4.56 |
| Thinner | 5.6 | 5,012 | 36,590 | 3.60 |
| Organic waste | 3.0 | 2,901 | 21,174 | 2.09 |
| Hydroxides | 2.5 | 2,668 | 19,475 | 1.92 |
| Chiller pipe cleaning solution | 2.9 | 2,569 | 18,755 | 1.85 |
| Solvents | 1.3 | 1,295 | 9,453 | 0.93 |
| Acids | 1.2 | 1,210 | 8,834 | 0.87 |
| Chromium solution | 1.0 | 90 | 7,223 | 0.71 |
| Isostatic press cleaner | 0.9 | 919 | 6,705 | 0.66 |
| Totals of major waste streams | 107.2 | 102,445 | 747,849 | 74 |
| Total liquid hazardous waste (incl. ER) | 144.6 | 139,120 | 1,015,573 | 100 |

**Table 3-11: Major Hazardous Solid Waste Streams**

| Major Solid Waste Streams | Vol. ($m^3$) | Wgt. (kg) | Disposal Cost @ $7.3/kg | % of Total |
|---|---|---|---|---|
| Non-ER hazard-ous soils | 152.5 | 180,941 | 1,320,872 | 88 |
| Fluorescent light bulbs | 182.0 | 14,616 | 106,694 | 7 |
| Incinerator ash | 14.4 | 9,186 | 67,054 | 5 |
| ER soils @$2.00/kg | 6,358 | 6,301,508 | 12,603,015 | |
| Solid totals ex-cluding ER wastes | 348.9 | 204,742 | 1,494,620 | |
| Solid totals in-cluding ER wastes | 6,706.6 | 6,506,250 | 13,237,717 | |
| % of total | 81% | 81% | 81 % | |
| LANL total solid waste | 8,267.1 | 8,043,086 | 15,113,209 | 100 |

- *Petroleum contaminated soils:* The strategy includes acquiring an available industrial technology for implementation and seeking regulatory approval of a bioremediation protocol to treat contaminated soils in place.
- *Fluorescent light tubes:* Approximately 70% of Laboratory fluorescent ballasts are of the old, magnetic variety with possible PCB contamination and cannot accept the new low-mercury, non-hazardous Philips Alto tubes. The remaining lighting fixtures have been upgraded to electronic ballast's at lower wattage and can accept low-mercury tubes. The Laboratory will convert to low-mercury tubes as the current lights require replacement. In addition, as the Laboratory's relamping program installs new fixtures and ballasts, new low-mercury tubes will be installed. Given the three year fluorescent tube replacement cycle, all new ballast fixtures should have low-mercury tubes by CY 2000. The success of this low-mercury tube solution hinges on these tubes passing the Toxic Characteristic Leaching Procedure (TCLP) test limit of 0.2 mg/L of mercury and follow-on approval of disposal of low-mercury tubes by the New Mexico Environment Department as non-hazardous waste.
- *Freon elimination:* During the past four years the Laboratory has significantly reduced use of freon and other ozone depleting substances. A comprehensive search and substitution initiative will be undertaken to eliminate all use of ozone depleting compounds.

In addition to these specific pollution prevention activities, the Laboratory will continue to encourage and support pollution prevention and waste minimization at the individual activity level.

### 3.4.5 Accomplishments in hazardous waste minimization

Considerable waste avoidance is accomplished at

**Table 3-12: Hazardous Waste Accomplishments**

| Pollution Prevention Activity | Waste Reduction (MT) | Cost Savings ($K) |
|---|---|---|
| **Off-site recycle** | | |
| Hazardous Materials | 64 | 991 |
| Electric Cable | 1 | 24 |
| Waste Oil | 68 | 280 |
| Used Tires | 5.5 | 57 |
| Lead | 23 | 552 |
| Lead and Steel | 28 | 146 |
| Lead Acid Batteries | 13 | 314 |
| **On-site Recycle/Reuse** | | |
| Antifreeze | 6 | 136 |
| Etchant and Stripper Chemicals | 21 | 495 |
| Chemicals | 1 | 39 |
| Cooling Tower Residue | 9 | 68 |
| Cutting Fluids | 0.01 | 1 |
| **Material Substitution** | | |
| Solvents | 0.2 | 2 |
| Solvent and Rags | 0.2 | 2 |
| **Segregation** | | |
| Soils | 5,455 | 1,091 |
| PPE | 0.1 | 3 |
| **Process Changes** | | |
| Decontamination Liquids | 0.4 | 4 |
| **Totals** | **5,695.4** | **4,205** |

the generator level with the assistance of either the ESO or support contractors. Table 3-12 lists accomplishments and the associated waste management waste cost avoidance for FY 1996.

### 3.4.6 Immediate, near-term, and out-year activities

*Immediate Priority - Implementation by FY 1998*

- Identify and develop pollution-prevention-based restrictions for Waste Acceptance Criteria.
- Implement bioremediation technology for hydrocarbon contaminated soils.
- Expand oil recovery system to capture all non-contaminated oils.
- Implement waste avoidance project for machine coolants.
- Implement silver recovery units for photo-chemical waste stream.
- Replace high mercury fluorescent bulbs with low mercury bulbs.
- Develop a system model for hazardous waste.
- Establish generator or facility-specific programs to reduce pollutants.

*Near-Term Priority - Implementation by FY 1999*

- Evaluate procedures for rinsing and decontamination to reduce waste water volume.
- Identify major opportunities and develop projects to reduce or eliminate waste streams.
- Transfer responsibility for project funding to generator organizations.
- Re-institute the Chemical Substitution Committee.
- Develop comprehensive hazardous waste systems model.
- Revise procurement practices to implement source elimination.
- Modify specifications and contracts to include waste minimization.

*Out-year Activities - Implementation by FY 2000*

- Research and develop support of waste avoidance technologies.
- Implement chemical substitutions through procurement.
- Transfer waste costs to generators.
- Complete incentives programs.
- Investigate potential for regulatory review/reform.

Out-year project design and implementation will be defined and developed as opportunities present both the technical feasibility and economic value required to achieve a reasonable return on investment specific to waste stream activity.

### 3.4.7 Performance measures and goals

The ultimate objective is to develop out-year projects that assist in meeting a future DOE pollution prevention goal of reducing expected waste generation by another 50% by the year 2006 as well as meet the waste avoidance projections of the DOE/EM Ten Year Plan.

The most immediate performance measure is the DOE pollution prevention goal of achieving a 50% reduction in routine hazardous waste by 1999 as compared to a 1993 baseline.

Performance measures for which other goals will be developed are:

- the number of separate chemical containers in the Laboratory's chemical inventory (as measured by the Automated Chemical Inventory System [ACIS]);
- the number and volume of unexpended chemicals sent to TA-54 for disposal normalized to the Laboratory's chemical inventory (as measured by the Chemical and Low Level Waste database);
- the volume fraction of non-ER hazardous wastes that are recycled outside the Laboratory (as measured by the Stewardship waste avoidance database); and
- the amount of funds spent on off-site disposal of hazardous waste (as measured by the Waste Management Projects Control System).

Investigation of these measures and communication with waste generators about them are required to evaluate their utility and set meaningful goal values.

## *3.5 Sanitary waste minimization*

### 3.5.1 Background

Reducing both routine and nonroutine sanitary waste generation and increasing the percentage which is recycled requires that source reduction or reuse and recycling of waste streams be as easy and cost-effective as disposal; that all employees be aware of existing minimization methods; and that managers encourage their people to use existing opportunities and create new ones. Paper and cardboard waste prevention and reuse; equipment reuse; and construction/demolition waste prevention and material reuse are top priorities for this program.

The ESO has identified all materials currently being recycled at the Laboratory, documented the recycling pathways and contacts for each material, and advertised recycle pathways and contact information on an Internet recycling homepage at: http://perseus.lanl.gov/PROJECTS/RECYCLE/. The ESO has used the documents to identify methods to streamline current recycling processes so that generators may more easily participate in them, and that the recycling pathways cost less for the Laboratory to operate.

Some of the streamlining methods implemented include: partnering with the Sandia National Laboratory's baling operation to fetch a higher market value for paper sold for recycle; introducing a system to collect "mixed recyclable" material (steel cans, aluminum cans, plastic containers, newspaper, *etc*.) so that there is no distinction between what can be recycled residentially and at the Laboratory; partnering with the Los Alamos County Landfill to accept the mixed recyclable material into their residential waste stream; and leveraging the environmentally conscious behavior and established infrastructures of the main service subcontractor to the Laboratory and the County Landfill to achieve a maximum percentage of materials recycled. The Laboratory currently recycles ~80% of its total sanitary waste as shown in Table 3-13 and Figure 3-11.

This high percentage is due largely to the innovative work practices at the County Landfill which partners with and is supported by the Laboratory. Concrete rubble constituted an average of 52% of the total sanitary waste generation in FY 1993 – FY 1996. Whereas the Laboratory is able to use some of its soils and rubble as fill on site, the County Landfill is able to use a larger volume of rubble as fill for a land bridge between two canyons at the Landfill, thereby diverting the rubble from disposal in their pit.

Other reuse options are being considered by the Landfill and the Laboratory after the bridge is complete. Had the rubble not been reused, the Laboratory would have averaged a recycling rate of 26% in FY 1993 - FY 1996, increasing the recycling rate from 14% in FY 1993 to nearly 45% in FY 1996. The Laboratory/County partnership has also resulted in the recycle of metals, construction/demolition debris, and brush that may have otherwise been disposed of.

**Table 3-13: Routine and nonroutine sanitary waste by Fiscal Year (1993 – 1996)[1]**

| | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|
| **Routine not recycled** | 2,508 | 2,322 | 2,440 | 2,064 |
| **Routine recycled** | 349 | 305 | 342 | 390 |
| **Nonroutine (all recycled)** | 7,382 | 7,417 | 6,523 | 9,598 |
| **Total** | 12,232 | 12,038 | 11,300 | 14,048 |
| **Percent Recycled** | 63% | 64% | 61% | 71% |

[1] - In metric tonnes. Routine includes routine trash sent to the Los Alamos County landfill + paper recycled + sludge generated. Nonroutine includes nonroutinely generated materials sent to the County Landfill + materials reused or recycled on-site + materials recycled off-site.

The Solid Waste Management Solutions Group (SWMSG) was formed from the Laboratory's Recycling Task Force to distribute information on existing recycling pathways and solicit ideas for streamlining and expanding the current programs. The SWMSG discusses field experience regarding successes and barriers to reducing non-radioactive waste streams. Other more specific groups exist in the Laboratory to complement the SWMSG such as the Construction Team Roundtable which was formed to address construction issues during upgrade of the CMR facility. These groups are essential to formulating and disseminating program priorities.

In addition to making it as easy as possible for the generators to avoid generating or to recycle sanitary material, it is important to emphasize that pollution prevention be considered in purchasing as well. Recycling will not be a viable alternative to disposal as long as the market for goods containing recycled content is low. The existence of the groups mentioned above is considered important to disseminating information about available products. Implementation of affirmative procurement into Laboratory procurement practices is also important to meet EPA goals and to demonstrate Laboratory commitment to recycling.

### 3.5.2 Waste stream description

Routine sanitary waste generated at the Laboratory consists of trash from administrative, custodial, and canteen operations disposed of in the Los Alamos County Landfill; and sludge generated from the TA-46 sanitary waste water treatment facility. Nonroutine sanitary waste consists of waste from operations such as construction and D&D projects, cleanouts and rebuilds, environmental restoration activities, and landscaping activities.

The trend of total routine and nonroutine sanitary waste generation (waste materials sent to the County Landfill + on-site reuse or recycle + off-site recycle) is shown Table 3-13 and Figure 3-11.

In years FY 1997 and beyond, a continued downward trend of routine sanitary waste generation is expected due to increased emphasis on source reduction opportunities available to administrative, custodial, and canteen personnel; and introduction

**Table 3-14: Major routine sanitary waste streams (1993 estimate)**

| Waste stream | Percent of Total |
|---|---|
| paper (includes cardboard) | 57.6% |
| office supplies | 10.0% |
| plastic | 9.2% |
| food | 6.0% |
| metals | 4.7% |
| yard waste, wood | 4.6% |
| laboratory waste (kim wipes, etc.) | 2.9% |
| "household hazardous waste" | 1.9% |
| glass | 1.7% |
| rubber, textile, leather | 1.4% |
| Total | 100.00% |

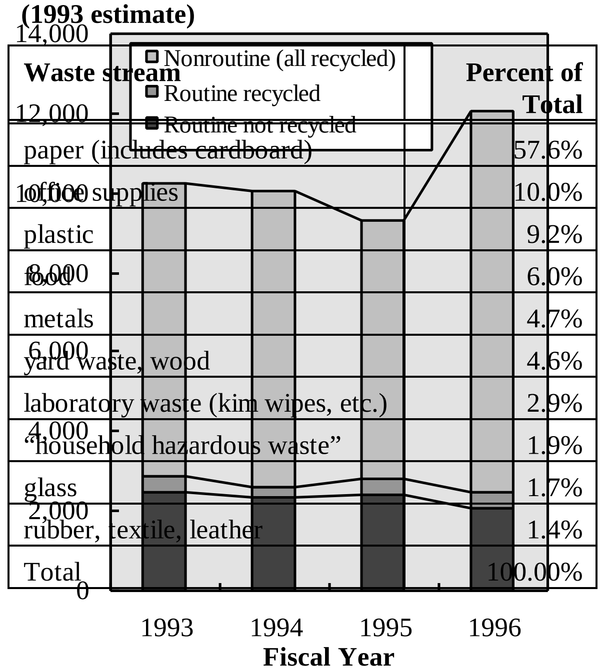



**Figure 3-11: Sanitary waste volume by fiscal year**

of a more inclusive, but streamlined recycling/reuse program. Nonroutine waste generation is difficult to predict by definition, however, it is expected to increase in FY 1997 - FY 1999 because of the implementation of the following projects:

- The Green Is Clean Program (described in section 3.3 – LLW Minimization) will increase the amount of nonroutine sanitary waste disposed of by verifying suspect LLW as clean. Materials released during the first few years of the program will be disposed of in the County Landfill until risk assessments on releasing the material for recycling can be performed;
- The RCA Reduction program (described in section 2.5 – LLW Program) will allow materials from these areas to be disposed of in the sanitary waste stream instead of being disposed of as LLW.

Continued construction and demolition projects will produce a variety of wastes, much of which may not be reusable or recyclable.

### 3.5.3 Participating facilities

Every Laboratory facility contributes to the routine sanitary waste trash waste stream through

**Table 3-15: Major nonroutine sanitary waste streams (CY 1993 - CY 1996 average)**

| Waste Stream | Percent of Total |
|---|---|
| Concrete Rubble | 84.5% |
| Other Construction/Demolition Debris | 12.8% |
| Brush | 1.5% |
| Miscellaneous Metals | 1.2% |
| Total | 100.0% |

administrative, custodial, and canteen operations. Because sanitary waste disposal cannot currently be tracked back to the generating facility, it is difficult to determine the specific facilities that are the major contributors. Routine sanitary waste disposal is tracked at the level of facility management units (FMUs), providing the general location of most generation. (FMUs consist of one or more occupied or unoccupied structures within a technical area.) Figure 3-12 shows the five FMUs with the highest estimated annual number of dumpster pickups.

These five FMUs account for ~65% of all annual dumpster pickups and span 26 different technical areas including the Pueblo Complex buildings on the edge of the site and the Johnson Controls, Inc. town site offices. As part of the sanitary waste program, tracking dumpster content to the building level is planned. The TA-46 sanitary waste water treatment facility is the sole generator of routine sanitary waste sludge.

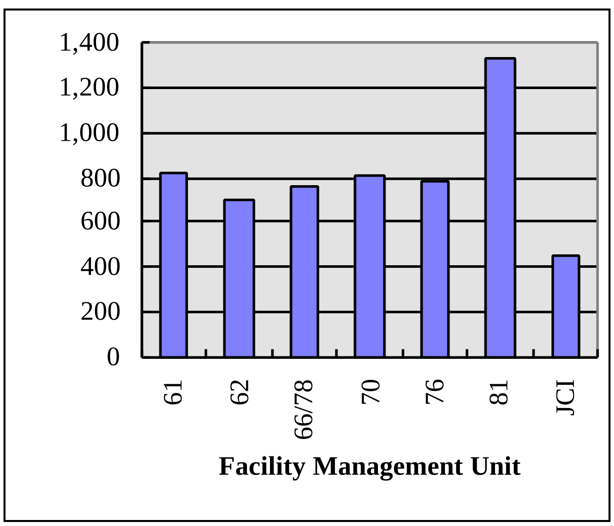



**Figure 3-12: Estimated annual dumpster pickups by Facility Management Unit (FMU)**

Nonroutine waste generation can also occur at any facility. Some of the major construction/D&D activities in CY 1997 will occur at TA-21, TA-35, SIGMA, and CMR. RCA reduction efforts are occurring in these areas as well. The Green is Clean program has been implemented at TA-48, TA-43, and TA-55. Procedures are currently being developed that will allow implementation of the Green is Clean program at TA-50, TA-46, TA-59, and in Environmental Restoration projects at various locations throughout the site. Materials released by the Green Is Clean Program could affect both routine and nonroutine sanitary waste generation.

### 3.5.4 Largest waste streams

According to the *Los Alamos National Laboratory Solid Waste Characterization Study* (July 30, 1993), the constituent breakdown of the routine sanitary waste trash waste stream is shown in Table 3-14.

As part of the sanitary waste program, “dumpster dives” are planned to verify these results and identify FMU and/or building-specific source reduction and recycling opportunities.

The Laboratory currently recycles 100% of its documented nonroutine waste volume. The percentage breakdown of nonroutine waste stream components is presented in Table 3-15.

### 3.5.5 Strategy and current targets

Priority wastes are paper, cardboard, discarded equipment, and construction/demolition debris (including concrete rubble). The primary strategy is to improve the cost effectiveness and percentage of material recycled by streamlining current processes and leveraging existing State, Pueblo, Laboratory, and County programs. No projects have currently been identified for this waste type apart from the recycling portion of the pollution prevention base program.

### 3.5.6 Immediate, near-term, and out-year activities

*Immediate Priority - Implementation by FY 1998*

- Streamline current recycle pathways and advertise their availability to expand the number of recycling program participants.

- Implement procedures for reusing packing materials, and reducing disposal of packing material (working with vendors to take back pallets, foam forming, *etc*.).
- Promote Affirmative Procurement in purchasing through the incorporation of a Laboratory contract clause that mandates the purchase and tracking of materials containing recycled content.
- Track dumpster loads to building level and work with building managers to identify source reduction and recycling initiatives for their area.
- Establish middle- and upper-management buy-in by illustrating waste/cost avoidance of source reduction, on-site reuse, and off-site recycle techniques. On-site techniques emphasized will be the Construction Materials Recycle Center, and services offered through redistribution and marketing.
- Ensure that construction/upgrade and D&D groups have access to pollution prevention support staff who can assist in identifying sanitary waste minimization opportunities in the design phase of projects.

*Near-Term Priority - Implementation by FY 1999*

- Establish quantitative levels of Affirmative Procurement materials that must be purchased.
- Increase double-sided copying through awareness program and Laboratory Standards.
- Reduce paper generation through increased reliance on electronic mail and Internet posting of information.
- Expand the variety of commodities that can be recycled at the Laboratory based on generator input and cost/benefit analyses.
- Encourage the establishment of a paper baling operation in northern New Mexico to decrease transportation costs incurred by the recycling program.
- Connect the Laboratory's excess material system with the DOE Complex-wide program for materials exchange.

*Out-year Activities - Implementation by FY 2000*

- Benchmark expanded recycling program against other DOE and private industry site-wide recycling programs.
- Perform cost/benefit analyses of developing products that could be produced on-site from Laboratory-generated sanitary materials.

#### 3.5.7 Performance measures and goals

Meeting the immediate, near, and out-year priorities by their implementation dates will illustrate the success of this program. A successful sanitary waste minimization program will be one that has established reduction and recycling as methods that are as easy and cost-effective to follow as disposal pathways, resulting in decreased disposal and an increased recycling rate. Meeting the DOE pollution prevention goals for sanitary waste volume reduction (33%), sanitary waste recycling (33%), and affirmative procurement of EPA-designated items (100%) are also important measures of performance.

# 4 Measurement of pollution prevention success at the Laboratory

## *4.1 Objectives and end states*

The objective of the pollution prevention program at the Laboratory is ensure that no waste is generated that could practicably be avoided. This objective is difficult to measure because it aims to make avoiding polluting activities an operational value, subject to constant improvement. Demonstrating directly that decisionmaking at all levels of the Laboratory includes pollution prevention as a criterion may not be possible. However, the list of current and planned activities contained in the various sections of this plan indicate three main areas where completion can be judged, in most cases objectively. These three areas overlap the three main functions defined for the ESO in Chapter 2.

The first, gathering and disseminating data, can be measured by the record of standard reports generated through the ESO over the three year period. These will also document the trends in the various waste types, which will show whether absolute reductions in waste generation have been achieved, and whether changing missions have affected the generation rate. The preferred end state of this function is that every Laboratory employee knows what wastes he or she generates.

The second, marketing pollution prevention, which aims at changing the operational culture at all levels and for all types of operations, can be measured through evaluation of the presence and quality of training added to Laboratory training programs, as well as by submittal rates to Awards programs and calls for pollution prevention proposals. The end state for this function is that every Laboratory employee acts routinely to avoid generating avoidable waste.

The third function, brokering projects, can be measured by absolute funding profiles for pollution prevention projects through various sources, as well as through the proportions of mission funds to pollution prevention funds. However, the more effectively pollution prevention is incorporated as a central value in management and operational planning, the more difficult it will be to separate that part of mission funding which supports pollution prevention from that funding other operational improvements. The end state for this function is stable funding from mission programs to identify activities whose waste generation rate could be reduced without significant impact to safety or mission completion.

Tables 4-1, 4-2, and 4-3 attempt to correlate current and planned actions supporting pollution prevention with the DOE priorities and out-year activities identified in the DOE Pollution Prevention Program Plan (DOE, 1996). They list Laboratory activities from this plan, along with the waste types affected, and the current status of the activity (Complete or Continuing, In progress, or Planned). The tables indicate that substantial progress has already been made in meeting the immediate goals of the DOE, and a very diverse program of generator-specific projects is underway. A number of other near-term priorities are already being addressed, and even some out-year activities have been started.

## *4.2 DOE pollution prevention priorities and Los Alamos National Laboratory program activities*

**Table 4-1: Relationship of Laboratory activities to DOE Immediate Priorities**

| Laboratory Activity | Waste Type | Status |
|---|---|---|
| ***DOE Priority I.1 – Establish senior management commitment*** | | |
| Establishing a Conservation Solutions Group | ALL | C |
| Establishing a Pollution Prevention Council | ALL | C |
| Preparing Site Pollution Prevention Plan | ALL | C |
| Providing waste generation and waste avoidance data to division managers | ALL | C |
| Providing waste generation and avoidance performance data to managers for consideration in subordinate manager’s annual appraisals | ALL | I |
| Integrating standard as part of Appendix G of the 1998 UC contract | ALL | I |
| Establishing management buy-in by illustrating waste/cost avoidance of source reduction, on-site reuse, and off-site recycle techniques | ALL | I |
| ***DOE Priority I.2 – Set quantitative source reduction and recycling goals*** | | |
| Redesigning recycling program | SAN | C |
| Identifying all materials currently being recycled at the Laboratory | SAN | C |
| Documenting the recycling pathways and contacts for each material | SAN | C |
| ***DOE Priority I.3 – Institute performance measures*** | | |
| Responding to DOE requests for information and review | ALL | C |
| Incorporating pollution prevention performance measures in Appendix F of the contract between the University of California (UC) and DOE | ALL | C |
| Collecting, analyzing, reporting data for data calls, performance measures, and other required reports | ALL | C |
| Developing internal performance measures for increased production activity | TRU | I |
| Establishing quantitative levels of Affirmative Procurement materials that must be purchased | SAN | P |
| ***DOE Priority I.4 – Implement cost-saving pollution prevention projects*** | | |
| Identifying priority waste streams for source reduction opportunities | ALL | I |
| Developing and broker waste minimization projects | MLLW | I |
| Initiating electrochemical decontamination of hazardous and mixed wastes | MLLW | P |
| Partnering with (n,p) Energy, Inc. to recycle 2,000 $m^3$ of metal LLW | LLW | C |
| Reducing the size of RCA and enforcement of the procedure to prevent unnecessary items from entering RCAs | LLW | I |
| Reducing volume of LLW scrap metal by 2400 $m^3$ through decontamination and recycling | LLW | I |
| Procuring size reduction equipment, for use at TA–54 and at construction/ demolition projects | LLW | P |
| Partnering with JCI and Los Alamos County to recycle 77% of sanitary waste | SAN | C |
| ***DOE Priority I.5 – Design pollution prevention into new products, processes, and facilities*** | | |
| Developing employee training modules on pollution prevention and waste minimization | ALL | C |
| Preparing a waste minimization plan for TA-55 | ALL | C |
| Providing waste minimization support to Capability Maintenance and Improvement Project | ALL | I |

**Waste Types** **Status**

| | | |
|---|---|---|
| All – affects all waste types | LLW – Low level waste | C – Complete or continuing |
| TRU – Transuranic and mixed transuranic waste | HAZ – RCRA, State, TSCA waste | I – In progress |
| MLLW – Mixed low level waste | SAN – Sanitary waste | P – Planned |

| Laboratory Activity | Waste Type | Status |
|---|---|---|
| ***DOE Priority I.5 (cont.) – Design pollution prevention into new products, processes, and facilities*** | | |
| Implementing electrolytic glove box decontamination for rebuilds, upgrades, D&D, and legacy waste treatment | TRU | P |
| Reducing area of RCAs by 50,000 $ft^2$, and increasing the free release from RCAs through decontamination and radiological surveying | LLW | C |
| Developing procedures and instruments to verify materials as "clean" for disposal or recycle | LLW | I |
| Integrating recycling and waste avoidance opportunities in engineering design, specification, and standard work practices for upcoming ER projects, facility upgrades and construction | LLW | P |
| Connecting Laboratory excess material system with DOE-Complex materials exchange program | SAN | P |
| Streamlining current recycling pathways and advertise their availability to expand the number of recycling program participants | SAN | I |
| ***DOE Priority I.6 – Ensure that programs comply with Federal, State and Departmental directives*** | | |
| Coordinating the base program with Pollution Prevention projects, and Waste Type Managers | ALL | C |
| Preparing the annual Affirmative Procurement Report | ALL | C |
| Developing a Waste Minimization and Pollution Prevention Laboratory Standard | ALL | I |
| Developing Laboratory Performance Requirements for waste/pollution streams, and conservation | ALL | P |
| Developing Laboratory Implementing Guidance as necessary | ALL | P |

**Table 4-2: Relationship of Laboratory activities to DOE Near-Term Priorities**

| Laboratory Activity | Waste Type | Status |
|---|---|---|
| ***DOE Priority N.1 – Implement Generator-specific pollution prevention programs*** | | |
| Organizing pollution prevention consultant teams for the ER Project, major upgrades projects and construction and upgrades planning | ALL | C |
| Targeting waste streams and minimization options for each waste type | ALL | I |
| Providing waste minimization and pollution prevention assistance to generators | ALL | I |
| Identifying major opportunities and develop projects to reduce or eliminate waste streams | ALL | P |
| Developing and implementing hydride-dehydride process for plutonium recover. | TRU | C |
| Developing dry machining for plutonium, which avoids contaminated machining oils/coolants | TRU | C |
| Decontaminating ductwork in TA-21 to reduce 120 $m^3$ of TRU waste to LLW | TRU | C |
| Developing/implementing pyrochemical processing of plutonium salts | TRU | I |
| Completing testing of waste minimizing improvements to TA-55 nitric acid process line | TRU | I |
| Implementing vitrification of nitric acid evaporator bottoms, through hot testing | TRU | P |
| Implementing process improvements to TA-55 nitric acid line | TRU | P |
| Continuing electrolytic decontamination of gloveboxes for upgrade projects | TRU | P |
| Completing implementation of vitrification of nitric acid evaporator bottoms | TRU | P |

| **Waste Types** | | **Status** |
|---|---|---|
| All – affects all waste types | LLW – Low level waste | C – Complete or continuing |
| TRU – Transuranic and mixed transuranic waste | HAZ – RCRA, State, TSCA waste | I – In progress |
| MLLW – Mixed low level waste | SAN – Sanitary waste | P – Planned |

| LANL Activity | Waste Type | Status |
|---|---|---|
| ***DOE Priority N.1 (cont.) – Implement Generator-specific pollution prevention programs*** | | |
| Reducing of RCA area, MLLW volume, and shipping container waste by medical isotope lab | MLLW | C |
| Beginning recycling of uranium metal machine waste | MLLW | P |
| Initiating semivolatile extraction waste minimization | MLLW | P |
| Commencing stabilization of non-compliant liquid low-level wastes | MLLW | P |
| Initiating generator treatment of aqueous MLLW | MLLW | P |
| Completing implementation of supercritical $CO_2$ cleaning of plutonium pits | MLLW | P |
| Completing implementation of Green Is Clean program at TA-55, TA-48, and TA-53 | LLW | I |
| Expanding and improving LLW Green Is Clean and monitoring programs | LLW | I |
| Testing segregation procedures to eliminate mixing compactible and non-compactible wastes | LLW | P |
| Implementing use of ER soils as fill for TA–54, Area G LLW disposal facility | LLW | P |
| Pilot testing of MADAM box counter systems to segregate and release LLW asbestos | LLW | P |
| Identifying and funding pollution prevention projects to reduce ER generation of LLW soil | LLW | P |
| Identifying and funding projects to decontaminate and release contaminated equipment and building debris from upgrade projects | LLW | P |
| Avoiding RCRA wastes (plating shop rinse water) with evaporative recycling system | HAZ | I |
| Expanding oil recovery system to capture all non-contaminated oils | HAZ | I |
| Implementing silver recovery units for photochemical waste stream | HAZ | I |
| Replacing high mercury fluorescent bulbs with low mercury bulbs | HAZ | I |
| Implementing waste avoidance project for machine coolants | HAZ | I |
| Establishing generator or facility-specific programs to reduce pollutants | HAZ | P |
| Evaluating procedures for rinsing and decontamination to reduce waste water volume | HAZ | P |
| Implementing bioremediation technology for hydrocarbon contaminated soils | HAZ | P |
| Partnering with County to accept mixed recyclable material in residential waste stream | SAN | C |
| Collaborating with JCI, and Los Alamos County to achieve 80% recycling of sanitary wastes | SAN | C |
| Implementing procedures for reusing and reducing disposal of packing material | SAN | I |
| Encouraging establishment of a paper baling operation in northern New Mexico to decrease transportation costs incurred by the recycling program | SAN | P |
| Partnering with Sandia National Laboratory baling operation for higher recycled paper price | SAN | C |
| Continuing support of closed-loop recycle for TA-55 hydrochloric acid process line | TRU | P |
| Developing a construction materials recycle center, redistribution and marketing center, and CHemical Exchange Assistance and External Recycle Program (CHEAPER) | HAZ | C |
| ***DOE Priority N.2 – Reduce release of toxic chemicals*** | | |
| Writing waste minimization plans for air emissions, effluent outfalls, and energy conservation | ALL | P |
| Implementing nitric acid recycle | TRU | P |

| | | |
|---|---|---|
| Developing closed-loop recycle for TA-55 hydrochloric acid process line through use of MgO crucibles as caustic precipitation agent in line | TRU | P |
| ***DOE Priority N.3 – Establish pollution prevention budgets based upon Activity Data Sheets*** | | |
| Transferring responsibility for project funding to generator organizations | ALL | P |

| **Waste Types** | | **Status** |
|---|---|---|
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| **LANL Activity** | **Waste Type** | **Status** |
|---|---|---|
| ***DOE Priority N.4 – Perform pollution prevention cost/benefit analyses*** | | |
| Conducting a cost/benefit analysis of melting of metal for reuse | LLW | C |
| Expanding the variety of commodities recycled at the Laboratory based on generator input and cost/benefit analyses | SAN | P |
| Benchmarking recycling program against DOE/private industry site-wide recycling programs | SAN | P |
| Performing cost/benefit analyses of products that could be produced on-site from Laboratory-generated sanitary materials | SAN | P |
| ***DOE Priority N.5 – Facilitate technology transfer and information exchange*** | | |
| Designating waste type coordinators for each waste type | ALL | C |
| Developing a system framework, and a waste type strategy | ALL | I |
| Developing of the systems flow sheets and waste stream analysis for waste types | ALL | I |
| Maintaining information distribution channels | ALL | C |
| Completing MLLW analysis and model | MLLW | I |
| Developing a system model for hazardous waste | HAZ | I |
| Reducing paper generation by increased reliance on electronic mail and Internet posting | SAN | P |
| Tracking dumpsters loads to building level and work with building managers to identify source reduction and recycling initiatives for their area | SAN | I |
| Ensuring access of construction/upgrade and D&D groups to pollution prevention support staff in the design phase of projects | SAN | I |
| Forming the Solid Waste Management Solutions Group to discuss field experience regarding successes and barriers to reducing non-radioactive waste streams | SAN | C |
| Forming the Construction Team Roundtable to address CMR upgrade construction issues | SAN | C |
| Re-instituting the Chemical Substitution Committee | HAZ | P |
| Developing comprehensive hazardous waste systems model | HAZ | P |
| Advertising recycle pathway and contact information on an Internet recycling homepage | SAN | C |
| Streamlining current recycling processes to ease generator participation, and reduce cost | SAN | C |
| ***DOE Priority N.6 – Implement pollution prevention employee training and awareness programs*** | | |
| Managing the Pollution Prevention Award Programs | ALL | C |
| Preparing the *P2 Reporter* | ALL | C |
| Developing a pollution prevention training module | ALL | C |
| Preparing annual ER Project pollution prevention awareness plans documenting waste reduction strategies and waste avoidance successes | ALL | C |

| | | |
|---|---|---|
| Preparing pollution prevention plans for construction upgrades projects at CMR building and decommissioning projects | LLW | C |
| Collecting "mixed recyclable" material comparable to residential recycling programs | SAN | C |
| Increasing double-sided copying through awareness program and Laboratory Standards | SAN | P |

**Waste Types**
All – affects all waste types
TRU – Transuranic and mixed transuranic waste
MLLW – Mixed low level waste
LLW – Low level waste
HAZ – RCRA, State, TSCA waste
SAN – Sanitary waste

**Status**
C – Complete or continuing
I – In progress
P – Planned

**Table 4-3: Relationship of Laboratory activities to DOE Out-Year Activities**

| LANL Activity | Waste Type | Status |
|---|---|---|
| *DOE Activity O.1 – Implement environmentally sound pollution prevention procurement practices* | | |
| Integrating pollution prevention tools into the Total Integrated Procurement System (TIPS) | ALL | I |
| Revising procurement practices to implement source elimination | HAZ | P |
| Implementing chemical substitutions through procurement | HAZ | P |
| Marketing purchase of products with recycled materials content and | SAN | C |
| Standardizing use of launderable PPE | LLW | I |
| Implementing material substitution and inventory control efforts in TA-55 and CMR | LLW | P |
| Promoting Affirmative Procurement in purchasing through incorporation of a Laboratory contract clause that mandates purchase and tracking of materials containing recycled content. | SAN | I |
| *DOE Activity O.2 – Integrate pollution prevention into research, development, demonstration, test, and evaluation programs* | | |
| Implementing in-line monitoring of TRU wastes | TRU | P |
| Developing out-year projects for TRU waste minimization | TRU | P |
| Researching and developing support of waste avoidance technologies | HAZ | P |
| *DOE Activity O.3 – Make all DOE policies, orders, and procedures consistent with regard to pollution prevention* | | |
| Implementing waste reduction strategies for free release of minimally contaminated materials | LLW | P |
| Identifying and developing pollution prevention restrictions for Waste Acceptance Criteria | HAZ | I |
| *DOE Activity O.4 – Implement pollution prevention outreach and public involvement programs* | | |
| Encouraging public participation in pollution prevention planning and implementation | ALL | I |
| *DOE Activity O.5 – Develop pollution prevention incentives programs* | | |
| Modifying specifications and contracts to include waste minimization | ALL | P |
| Transferring waste costs to generators | ALL | P |
| Completing incentives programs | ALL | P |
| *DOE Activity O.6 – Promote regulatory review and reform* | | |
| Publicizing activities that emphasize pollution prevention practices | ALL | C |
| Investigating potential for regulatory review/reform | ALL | P |

**Waste Types**

**Status**

| | | |
|---|---|---|
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| TRU – Transuranic and mixed transuranic waste | HAZ – RCRA, State, TSCA waste | I – In progress |
| MLLW – Mixed low level waste | SAN – Sanitary waste | P – Planned |

# 5 References and Acronym List

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## *5.2 Acronym List*

| | |
|---|---|
| ACIS | Automated Chemical Inventory System |
| ADS | Activity Data Sheet |
| AOT | Accelerator Operations & Technology Division |
| BUS | Business Operations Division |
| CFR | Code of Federal Regulations |
| CHEAPER | Chemical Exchange Assistance Program and External Recycle |
| CIC | Computing, Information, and Communications Division |
| CMIP | Capability Maintenance and Improvement Project |
| CMR | Chemical & Metallurgical Research Facility |
| CST | Chemical Science and Technology Division |
| CY | Calendar Year |
| D&D | Decontamination & Decommissioning |
| DNFSB | Defense Nuclear Facility Safety Board |
| DOE | Department of Energy |
| DOE/AL | Department of Energy Albuquerque Operations Office |
| DOE/DP | Department of Energy Defense Programs |
| DOE/EM | Department of Energy Environmental Management |
| DOE/HQ | Department of Energy Headquarters |
| DOE/ID | Department of Energy Idaho Operations Office |
| DX | Dynamic Experimentation Division |
| EM | Environmental Management |
| EM/SWO | Solid Waste Operations Group |
| EM/RLW | Radioactive Liquid Waste Group |
| EPA | Environmental Protection Agency |
| EPCRA | Emergency Planning and Community Right-to Know Act |
| ER | Environmental Restoration |
| ESA | Engineering Sciences and Applications Division |
| ESH | Environment, Health, and Safety Division |
| ESO | Environmental Stewardship Office |
| FFCO/STP | Federal Facility Compliance Order/Site Treatment Plan |
| FMU | Facility Management Unit |
| FRP | Fiberglass Reinforced Plywood |
| FY | Fiscal Year |
| GSAF | Generator Set-Aside Fee |
| HAZ | RCRA, TSCA, and State-regulated wastes |
| HE | High Explosive |
| HEPA | High Efficiency Particulate Air |
| JCI | Johnson Controls Incorporated |
| LANL | Los Alamos National Laboratory |
| LANSCE | Los Alamos Neutron Science Center |
| LIR | Laboratory Implementing Requirement |
| LPR | Laboratory Performance Requirement |
| LLW | Low-Level Radioactive Waste |
| MADAM | Multiple-Axis Dual Assay Measurement |
| MASS | Material Accountability and Surveillance System |
| MLLW | Low-Level Mixed Waste |
| MST | Materials Science & Technology Division |
| MTRU | Mixed Transuranic |
| NMT | Nuclear Materials Technology Division |
| NPDES | National Pollutant Discharge Elimination System |
| PCB | Polychlorinated Biphenyl |
| PPE | Personnel Protective Equipment |
| RCA | Radiological Control Area |
| RCRA | Resource Conservation and Recovery Act |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| SEN | Secretary of Energy Notice |
| SWEIS | Site-Wide Environmental Impact Statement |
| SWMSG | Solid Waste Management Solutions Group |
| TA | Technical Area |
| TCLP | Toxic Characteristic Leaching Procedure |
| TIPS | Total Integrated Procurement System |
| TRI | Toxic Release Inventory |
| TRU | Transuranic |
| TSCA | Toxic Substances Control Act |
| TSD | Treatment, Storage, and Disposal |

| | |
|---|---|
| UC | University of California |
| WAM-10 | Waste Assay Monitor, Model 10 |
| WAND | Waste Acceptance for Nonradioactive Disposal |
| WCRRF | Waste Compaction, Reduction, and Re-packaging Facility |
| WIPP | Waste Isolation Pilot Project |
| Z | Atomic Number |